(EEAP) BOILER AND CHILLER STUDY

AT

FORT SAM HOUSTON

SAN ANTONIO, TEXAS

FINAL REPORT

STATE OF TEXAS
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Fort Worth Division

CONDUCTED BY

HUITT-ZOLLARS, INC.

CONSULTING ENGINEERS

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TABLE OF CONTENTS

I. EXECUTIVE SUMMARY

A. Introduction

This energy conservation study was performed by Huitt-Zollars Inc, for the U.S. Army Engineer District (USAED), Fort Worth, under contract number DACAC63-94-D-0015. The study was conducted at Fort Sam Houston (FSH) in San Antonio, Texas, between November 28, 1994 and June 15, 1995. The site survey, data collection and analysis was performed by John Carter, E.I.T, Tom Holthaus, P.E., Walter H. Williams III, P.E., and C.A. Pieper, P.E..

The purpose of the study was to perform a limited site survey of specific buildings at the facility, identify specific Energy Conservation Opportunities (ECOs) that exist, and then evaluate these ECOs for technical and economic feasibility. These ECOs were limited to central boiler and chiller plant systems serving specific building groups at FSH.

This survey was conducted with the assistance of many individuals at the FSH facility. Special thanks are extended to all of them, including the following individuals:

Gerardo De La Pena, Energy Coordinator
Frank Carbonell, Engineering Service
Gene Rodriguez, Engineering Service
Ray Mendoza, Engineering Service
Mike Brynes, Operations and Maintenance
Henry Guerra, Operations and Maintenance
Al Mote, Energy Program Specialist

Other individuals who assisted in this study by providing equipment and cost data are listed as follows:

Tom McGreal, York International, Dallas, TX
John Neal, Sr., Neal and Associates, Dallas, TX
Joe Scolaro and Brian Mitchell, Mitchell Technical Sales, Dallas, TX
Preston Dickson, Timberlake and Woffard, Inc., Dallas, TX
Larry Carpenter, The Trane Company, Fort Worth, TX
David Recca, DynaService, Fort Worth, TX

Any questions concerning this report should be directed to the Project Manager at Huitt-Zollars Inc., 512 Main Street, Suite 1500, Fort Worth, Texas 76102. Phone 817-335-3000.

B. Buildings Studied

This study was performed on five separate groups of buildings at the Fort Sam Houston installation in San Antonio, Tx. These groups were identified as areas 100, 900, 1300, 2200 and Quadrangle. Buildings in each of these areas are briefly described as follows:

Area 100: These twenty buildings are currently used as office buildings, barracks, and other miscellaneous things such as a band rehearsal hall.

Area 900: These buildings consisted of sixteen barracks, four smaller support buildings and one large administrative building, all occupied by army personnel.

Area 1300: The buildings in this group consisted of six barracks, one dining hall and one administrative office building.

Area 2200: The four buildings in this group consisted of three barracks and one administrative office building, which were all approximately 25 years old.

Quadrangle: The four buildings in this group are all administrative offices, one of which serves as the headquarters of the 5th Army.

C. Present Energy Consumption

Base Year Energy Consumption: The total metered electrical and gas consumptions for 12 consecutive months, prior to this study, were obtained from the facility and are referred to as the 'base year'. These data are shown on page 12 and are summarized as follows:

Figure 1. Base Year Energy Usage By Source

ENERGY SOURCE	ANNUAL USAGE		COST $
Electricity	153,580 MWH	524,169 MMBTU	6,567,101
Natural Gas	51,415 MCF	51,415 MMBTU	192,985
Total		575,584 MMBTU	6,760,086

Boiler & Chiller Systems Energy Consumption: The annual energy consumption for the boiler & chiller systems studied was calculated in Appendix B, using the Trace 600 computer program to model the buildings and HVAC systems. This consumption amounted to a total of 11.1% of the base year energy usage and 7.4% of the energy costs. These system energy consumptions are given as follows:

Figure 2. Annual Boiler & Chiller Systems Energy Consumption

AREA	COOLING SYSTEM DEMAND $/YR	COOLING SYSTEM ELECT. KWH/YR	COOLING SYSTEM ELECT. $/YR	HEATING SYSTEM DEMAND $/YR	HEATING SYSTEM ELECT. KWH/YR	HEATING SYSTEM ELECT. $/YR	HEATING SYSTEM GAS MCF/YR	HEATING SYSTEM GAS $/YR
100	46,621	1,687,278	35,433	1,269	89,804	1,886	1,927	5,126
900	13,242	621,339	13,048	1,000	88,213	1,852	7,809	20,771
1300	67,861	3,019,253	63,404	2,687	259,249	5,444	18,751	49,878
2200	36,390	1,609,767	33,805	797	51,536	1,082	4,949	13,163
QUAD	51,292	1,633,303	34,299	221	6,096	128	1,210	3,220
SUBTOTALS	215,405	8,570,940	179,990	5,973	494,898	10,393	34,646	92,158
ANNUAL BOILER & CHILLER SYSTEM ENERGY				63,898 MMBTU/YR				
ANNUAL BOILER & CHILLER SYSTEM COST, $/YR				503,919 $/YR				

D. Energy Conservation Opportunity (ECO) Analysis

ECOs Rejected: After reviewing the data collected at the facility and considering all of the practical limitations involved, there were no potential ECOs which were rejected prior to performing calculations. Therefore, energy savings calculations were performed for all ECOs identified in the scope of work.

ECOs Recommended: Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility and are recommended for implementation. Complete documentation of all calculations as well as information required for implementation is included in Appendix D. These recommended ECOs are summarized in order of descending Savings to Investment Ratio (SIR) in Table 1 on page 6.

ECOs Not Recommended: Certain ECOs which were identified during the building survey have been evaluated for technical and economic feasibility but are not recommended for implementation. Complete documentation of all calculations are included in Appendix E. These non-recommended ECOs are summarized in order of order of descending SIR in Table 2 on page 6.

ECIP Projects Developed: The facility will submit three projects for ECIP funding, from the recommended ECOs shown in Table 1. The DD-1391 forms needed to request ECIP funding for each project are included in this report. These projects are listed below in order of descending SIR.

ECIP Project	Description	Cost $	Payback yrs	SIR
1	Chiller Retrofits, Areas 2200 & 900, Boiler Retrofit, Area 1300	558,058	7.7	2.27
2	Chiller Retrofit, Area 1300	479,191	8.4	1.98
3	New Central Chiller Plant, Area 100	556,559	8.6	1.73

Non-ECIP Projects Developed: The facility will also submit all ECOs indivudually as projects for non-ECIP funding. The DD-1391 forms needed to request non-ECIP funding for each project are included in this report. These projects are listed below in order of descending SIR.

Non-ECIP Project	Description	Cost $	Payback yrs	SIR
1	Chiller Retrofit, Area 2200	237,078	6.3	2.73
2	Chiller Retrofit, Area 900	157,256	8.9	2.08
3	Chiller Retrofit, Area 1300	479,191	8.4	1.98
4	Boiler Retrofit, Area 1300	163,724	9.6	1.79
5	New Central Chiller Plant, Area 100	556,559	8.6	1.73

Recommended Maintenance & Operations Practices: The following maintenance and operations (M&O) practices are recommended to help conserve boiler and chiller plant energy at FSH.

1. The Energy Coordinator and the FSH Director of Public Works should develop a master plan specification for all future central boiler and chiller plant maintenance and renovation projects. All facility project managers, as well as any central plant maintenance contractors should be required to follow this specification. The energy coordinator should review all new central boiler and chiller plant designs to check for compliance with the specifications.

2. The energy coordinator should attend training seminars for building energy.

3. The installation should increase the size of their current maintenance staff by adding trained HVAC technicians.

4. The installation should provide technical training for it's current HVAC staff, especially in the area of HVAC controls.

5. Revise the current HVAC preventative maintenance program as needed to improve the overall condition of the existing systems and equipment. The Energy Manager should be involved in this process to ensure that energy conservation concerns are addressed.

6. Add status, alarm, start and stop capabilities for all central boiler and chiller systems and auxiliaries to the post's existing building automation system. This will allow the maintenance staff to have better monitoring and control capabilities than they currently have.

7. Repair or replace all building HVAC control systems to improve space temperature control and conserve heating and cooling system energy.

E. Energy And Cost Savings

Total Potential Energy and Cost Savings. The energy and cost savings from the implementation of all ECIP projects was calculated as follows:

Electrical Energy Savings	8,690	MMBTU/yr
Electrical Demand Savings	49,884	$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	12,710	MMBTU/yr
Total Cost Savings	193,496	$/yr
Total Investment	1,593,808	$
Simple Payback	8.2	yrs

Energy Use and Costs Before and After. Based on the base year electrical and gas energy consumptions and costs shown on page 12, and the calculated total potential savings above, the FSH energy and usage and costs before and after implementation of the 3 Non-ECIP projects is as follows:

	Before	After
Electrical	153,580 MWH	151,033 MWH
Gas	51,415 MCF	47,395 MCF
Total Cost	6,760,086 $	6,566,590 $

Percentage Saved. Based on the base year electrical and gas energy consumptions and costs, the percentage of savings from the 3 projects is as follows:

$$Electrical\ Energy\ Saved = \left[\frac{2{,}546\ MWH}{153{,}580\ MWH}\right] = 1.6\%$$

$$Gas\ Energy\ Savings = \left[\frac{4{,}020\ MCF}{51{,}415\ MCF}\right] = 7.8\%$$

$$Energy\ Cost\ Savings = \left[\frac{193{,}496\ \$}{6{,}760{,}086\ \$}\right] = 2.8\%$$

TABLE 1. ENERGY CONSERVATION OPPORTUNITIES (ECOs) RECOMMENDED

ECO	Description	Electrical Energy Savings MMBTU/yr	Electrical Demand Savings $/yr	Gas Energy Savings MMBTU/yr	Total Energy Savings MMBTU/yr	Total Cost Savings $/yr	Total Investment $	Simple Payback Yrs	SIR
	AREA 2200								
E	Replace Existing Chiller With New Centrifugal Chiller	1,304	11,822	0	1,304	37,433	237,078	6.3	2.73
	AREA 900								
A	Replace Existing Central Chiller with Screw Chiller	434	2,520	0	434	17,650	157,256	8.9	2.08
	AREA 1300								
C	Replace Existing Chillers With Centrifugal Chillers	3,424	13,914	0	3,424	56,936	479,191	8.4	1.98
	AREA 1300								
D	Replace Existing Boilers With High % Modular Boilers	712	1,847	4,020	4,732	17,012	163,724	9.6	1.79
	AREA 100								
I	Replace Individual Chillers With Central Chiller Plant	2,816	19,781	0	2,816	64,465	556,559	8.6	1.73
	Totals	8,690	49,884	4,020	12,710	193,496	1,593,808	8.2	

TABLE 2. ENERGY CONSERVATION OPPORTUNITIES (ECOs) NOT RECOMMENDED

ECO	Description	Electrical Energy Savings MMBTU/yr	Electrical Demand Savings $/yr	Gas Energy Savings MMBTU/yr	Total Energy Savings MMBTU/yr	Total Cost Savings $/yr	Total Investment $	Simple Payback Yrs	SIR
	AREA 900								
B	Replace Existing Boilers With High % Modular Boilers	0	0	1,235	1,235	3,285	50,591	15.4	1.21
	QUADRANGLE AREA				0				
G	Replace Existing Chillers With Central Chiller Plant	2,212	14,116	0	2,212	39,257	824,178	20.9	0.71
	AREA 2200				0				
F	Replace Existing Boilers With High % Modular Boilers	38	378	910	948	3,037	78,553	25.8	0.69
	AREA 100				0				
J	Replace Existing Boilers With Central Boiler Plant	186	680	680	866	11,483	273,951	23.8	0.66
	QUADRANGLE AREA								
H	Replace Existing Boilers With Central Boiler Plant	-12	122	-434	-446	5,542	394,910	71.2	0.20
	Totals	18,066	100,722	10,431	28,497	394,513	4,415,465	11.2	

II. NARRATIVE REPORT

A. Entry Interview

Work Plan: An entry interview meeting was conducted at the Fort Sam Houston (FSH) facility on October 27, 1994. Present at the meeting were representatives of Huitt Zollars Inc. (HZ), Tom Holthaus, P.E., *Project Manager*, and Walter H. Williams III, P.E., *Mechanical Engineer*, as well as representatives from FSH, Gerardo De La Pena, *Energy Coordinator* and others. At that time, a description of the work plan for this study was presented. The work plan was a summary of the individual tasks to be performed to complete the boiler & chiller study and the approximate date that each task was to begin. Each step of the work plan was described in detail to the FSH staff. The work plan is shown in Figure 3.

Figure 3. Work Plan

10/3/94	Entry Interview
10/3/94	Building & Systems Data Collection
10/10/95	Formulate ECOs & Perform Calculations
6/15/95	Interim Findings Submittal
9/18/95	Pre-Final Report Submittal
10/30/95	Final Report Submittal

Data List: After discussing the work plan, the FSH staff was presented a list of data items to be collected by the study team, shown in Figure 4. This list was a summary of the information required by the surveyors. The study team and FSH staff discussed the methods by which all of the data on the list were to be obtained. The data concerning the existing boiler and chiller systems were to be collected from the buildings and recorded onto preprinted data forms. Building mechanical drawings were to be collected, information extracted and included on individual building data forms. All data forms are included in Appendix C. The FSH personnel provided direction as to where to obtain information on the list. They also provided useful information on past energy conservation efforts, as well as any ongoing or future planned energy conservation measures. One such project underway is the installation of a base wide building automation system, to control primary and secondary HVAC equipment in many buildings on the post.

Figure 4. Data Acquisition List

1. Existing central boiler and chiller systems.
2. Existing auxiliary systems in central plants.
3. Building HVAC system types and operational hours.
4. Building size, age and remaining useful life.
5. Existing building operational schedules and area usage.
6. Facility electricity, gas, other utility rates.
7. Facility electricity, gas, other utility consumptions.
8. Utility company rebate programs.
9. Past boiler and chiller energy conservation projects.
10. Proposed boiler and chiller energy conservation projects.
11. Typical boiler and chiller maintenance procedures and costs.
12. Typical boiler and chiller retrofit procedures.

ECO List: Following the discussion on the data list, the FSH personnel were presented a list of specific Energy Conservation Opportunities (ECOs) that were identified for evaluation in the Detailed Scope of Work (see pages F-11 through F-15). This list is shown in Figure 5. The first ECO specified was the upgrade or replacement of existing central chillers with more efficient systems. The scope specifically called for the evaluation of electric centrifugal chillers, electric centrifugals with variable frequency drives, electric screw chillers and gas driven centrifugal chillers. All of these types were evaluated as a means of saving energy and maintenance costs in the existing central chiller plants of areas 900, 1300 and 2200. The second ECO specified was the upgrade or replacement of existing central boilers with

more efficient systems. Since no specific types were identified, the most efficient alternatives were selected and evaluated as a means of saving energy and maintenance costs in the existing central boiler plants of areas 900, 1300 and 2200. The third ECO specified was the installation of new central chiller plants to replace the existing individual building chillers in areas 100 and the Quadrangle. These new central plant evaluations were similar to a 1986 central plant design for area 100 which was never implemented. The fourth ECO specified was the installation of new central boiler plants to replace the existing individual building boilers in areas 100 and the Quadrangle. In all ECOs, the annual energy consumption of the boilers, chillers and auxiliary equipment were calculated by computer simulations using the Trane Trace 600 program. Building data were used to accurately model each building such that a realistic load profile was created for simulating boiler and chiller operational patterns. In all ECO calculations, the required capacity of the existing central heating and cooling equipment was evaluated from the computer simulations and recommendations for proper sizing were made.

Figure 5. Specific ECOs List

1. Chiller replacement or retrofit.
2. Boiler upgrade or replacement.
3. Install central chiller plants.
4. Install central boiler plants.

B. Data Collection

Following the entry interview, the study team began the task of collecting the required data. First, building mechanical plans were studied and data was extracted. Then field surveys were made on all of the buildings in the study to verify and supplement data collected from the drawings. All of the data obtained from drawings and field survey were put onto data sheets and included in Appendix C. The following summarizes the data collection phase of this study.

Building Data: This study was performed on five separate groups of buildings and required two separate site visits to collect data. These groups were identified as areas 100, 900, 1300, 2200 and Quadrangle. Buildings in each of these areas are described as follows:

1. Area 900 - This area included buildings 902, 904, 905, 906, 907, 908, 915, 916, 917, 919, 920, 921, 922, 924, 925, 926, 928, 929, 930, 931 and 932. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group were constructed approximately 21 years ago and are mainly steel and concrete structures with brick veneer exteriors and flat built-up roofs. These buildings consisted of 16 barracks, four smaller support buildings and one large administrative building, all occupied by army personnel. All of the barracks were three story structures while the others were single story structures.

2. Area 1300 - This area included buildings 1350, 1374, 1375, 1377, 1379, 1380, 1382 and 1385. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group consisted of six barracks, one dining hall and one administrative office building. All buildings are approximately 24 years old except for 1350, which is only 12 years old. These buildings were all occupied by army personnel. All of these buildings are mainly steel and concrete structures with brick veneer exteriors and flat built-up roofs. All of the barracks were multi-story structures while the others were single story structures.

3. Area 2200 - This area included buildings 2263, 2264, 2265 and 2266. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group consisted of three barracks and one administrative office building, which were all approximately 25 years old. These buildings were all occupied by regular army personnel. All of these buildings are mainly masonry structures with stucco exteriors and pitched red clay tile roofs. All of the buildings were three story structures with both attic and basement spaces. One

of the barracks buildings has a dining hall, while another has a museum.

4. <u>Quadrangle</u> - This area included buildings 16, 44, 56 and 4015. A map of this area is included in Appendix C along with the data sheets for these buildings. The four buildings in this group are all administrative offices, one of which serves as the headquarters of the 5th Army. All but one are multi-story, with construction ranging from wood frame and siding with pitched shingle roofs to masonry structure, limestone exterior and pitched metal roof on the Headquarters building. These buildings are between 40 and 45 years old, and are considered historically significant.

5. <u>Area 100</u> - This area included buildings 122, 124, 125, 127, 128, 132, 133, 134, 135, 142, 143, 144, 145, 146, 147, 149, 197, 198, 199 and 250. A map of this area is included in Appendix C along with the data sheets for these buildings. The buildings in this group were constructed approximately 50 to 55 years ago and are mainly wood framed structures with brick veneer exteriors and pitched shingle roofs. Most all of these buildings were two story structures that had basement and attic spaces. These buildings are currently used as office buildings, barracks, and other miscellaneous things such as a band rehearsal hall. These buildings are occupied by both army and civilian personnel.

Central Plant & HVAC Systems Data:

1. <u>Area 900</u> - The buildings in this area are served by a central plant in building 902. The primary cooling system consists of a single 300 ton, centrifugal, water cooled chiller which is ten years old and uses R-11 refrigerant. A sixteen year old packaged, single cell crossflow cooling tower serves the chiller. Both the chiller and cooling tower appear to be in fair condition with many years of useful life remaining. The computer simulations of this area verified that the installed tonnage was both adequate and required to meet the building cooling loads.

   Primary heating systems consist of three gas fired, water tube, HW boilers. The combined output capacity of these sixteen year old boilers is approximately 4,995 MBH, and they appeared to be in fair condition with a few years of useful life remaining. The computer simulations of this area identified that the installed capacity was approximately 2 ½ times what is required to adequately meet the building heating loads.

   The individual chilled water (CHW) and condenser water (CND) pumps and multiple heating water (HW) pumps are located within the plant. These primary systems distribute thermal energy to the buildings through a four-pipe distribution loop. The domestic hot water (DHW) for the area is generated in the buildings through individual shell and tube heat exchangers in mechanical rooms, using HW from the boilers. A single DHW circulation pump for buildings distributes the DHW to the plumbing fixtures. This design requires a boiler to operate year round to produce DHW. The other buildings have individual gas fired water heaters.

   Secondary HVAC systems in these buildings consist of two pipe fan coil units (FCUs) in the barracks, while multizone (MZ) and single zone (SZ) air handling units are located within the support and administrative buildings. Each pair of barracks buildings has a secondary pump to circulate HW or CHW from the central loop to all the FCUs. Overall HVAC system performance in this area is poor due in part to faulty or inadequate system controls, making space temperatures difficult to maintain. Also, the two-pipe distribution loops in the buildings and the four-pipe distribution loop from the central plant to the buildings are in poor condition with corrosion, leaks and missing or unserviceable insulation.

2. Area 1300 - The buildings in this area are served by a central plant in the dining hall building 1377. The primary cooling systems consist of two centrifugal water cooled chillers, rated at a combined 1200 tons, which are 23 years old and use R-11 refrigerant. These two chillers are piped in series and serve all of the buildings except for 1350. This newer building is served by a single 438 ton, water cooled centrifugal chiller that is 12 years old and uses R-11 refrigerant. A twelve year old, single cell cooling tower serves this chiller while a 23 year old, two cell tower serves the other two chillers. The older chillers and tower appeared to be in poor condition and nearing the end of useful life. The newer chiller and tower were in fair condition with some years of useful life remaining. The computer simulations of this area identified that the installed capacity of 1,424 tons was around 14% higher than what is required to meet the building cooling loads.

The primary heating systems consisted of two firetube, HW boilers which are 23 years old and have a combined output capacity of 11,824 MBH. These two boilers serve all of the buildings except for 1350. This building is served by two watertube, HW boilers which are 12 years old and have a combined output capacity of 9,653 MBH. The older boilers appeared to be in poor condition and are near the end of their useful life. The newest boiler was in fair condition with some years of useful life remaining. The computer simulations of this area identified that the installed capacity of 21,477 MBH was approximately 3 times what is required to adequately meet the building heating loads.

The three CHW pumps, three CND pumps and three HW pumps are located within the plant in building 1377. These primary systems distribute thermal energy to the buildings through two four-pipe distribution loops, which appeared to be in good condition. One loop is for building 1350 and the other is for all other buildings in the area. DHW is generated by individual gas fired water heaters in each building.

Secondary HVAC systems in these buildings consist of some two pipe FCUs and SZ air handlers, and many four pipe MZ air handling units located within the buildings. Each building has secondary CHW and HW pumps to circulate water from the central loops to all the FCUs and air handlers. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain.

3. Area 2200 - The buildings in this area are served by a central CHW plant in the basement of building 2265. The primary cooling system consists of a single 650 ton centrifugal, water cooled chiller, which is 22 years old and uses R-11 refrigerant. A 23 year old, single cell, built-up cooling tower is outside to serve the chiller. The chiller and tower appear to be in poor condition and nearing the end of useful service. The computer simulations of this area identified that the installed capacity was around 18% higher than what is required to meet the building cooling loads.

The primary heating systems consist of three watertube, HW boilers which are seven years old and have a combined rated capacity of 6,720 MBH. These boilers are all located in a separate mechanical building behind 2265 and appeared to be in good condition with many years of useful life remaining. The computer simulations of this area identified that the installed capacity was approximately 2 ½ times what is required to adequately meet the building heating loads.

A single CHW pump, CND pump and three HW pumps are located within the plants. These primary systems distribute thermal energy to the 2200 area buildings through a four-pipe distribution loop which appears to be in good condition. DHW is generated by individual gas fired water heaters in each building.

Secondary HVAC systems in these buildings consist of SZ and MZ air handlers located within the buildings. Each building has secondary CHW and HW pumps to circulate water from the central loop to all the FCUs and air handlers. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain.

4. <u>Quadrangle</u> - The buildings in this area have no central boiler or chiller plant. All buildings have stand alone primary heating and cooling systems. The primary cooling systems consisted of one 12 year old, air cooled, reciprocating chiller, rated at 50 tons and serving building 4015. This chiller appears to be in fair condition with at least 10 years of useful life remaining. Another two year old, air cooled, reciprocating chiller, rated at 30 tons serves building 56. This chiller appears to be in good condition with many years of useful life remaining. Building 16 is served by two air cooled, reciprocating chillers. One is only a year old and is rated at 120 tons. The other is eight years old and is rated at 110 tons. Both of these chillers appeared to be in good condition with many years of useful life remaining. Finally, building 44 is served by three chillers which are 10 years old and rated at a combined 225 tons. All three of these chillers appeared to be in good condition with many years of useful life remaining. All of these chillers operate on the R-22 refrigerant. The computer simulations of this area verified that the installed capacity of 565 tons was both adequate and required to meet the building cooling loads. However in some areas, especially in building 44, temperature control problems are apparent.

The primary heating systems consist of an eight year old, firetube HW boiler, with an output rating of 741 MBH, serving building 4015. This boiler appeared to be in good condition with many years of useful life remaining. Building 16 has two watertube, steam boilers which are 16 years old. One is rated at 1,614 MBH output and serves approximately half of the building. The other is rated at 3,587 MBH output and serves the other half of building 16 as well as all of building 56. These two boilers appeared to be in fair condition with some useful life remaining. Building 44 has 12 modular steam boilers which are 25 years old and have a combined output of 3,028 MBH. These boilers appeared to be in poor condition and are at the end of their useful life. The computer simulations of this area identified that the installed capacity was approximately 2 ½ times what is required to adequately meet the building heating loads.

The CHW pumps for all the chillers in the Quadrangle area are located within the buildings they serve. A single HW pump is located within building 4015 to circulate water through the buildings secondary systems. All other buildings have steam and condensate return piping from the boilers to all secondary systems. DHW is generated by individual gas fired water heaters in each building.

Secondary HVAC systems in the Quadrangle area buildings consist of dual duct, MZ and SZ air handling units as well as FCUs located in some areas of the buildings. These units all have steam coils for heat, except for those in building 4015, which have hot water coils. Some areas of building 16 and building 44 are cooled by direct expansion (DX) terminal units, with small cooling towers outside for condensers. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain. Because of the historical significance of this area, there is little space for a central plant. However, one could be located nearby with a historically correct wall built around it to hide the equipment.

5. <u>Area 100</u> - The buildings in this area have no central boiler or chiller plant. All buildings have stand alone primary heating and cooling systems. The primary cooling systems consist of 14

air cooled, reciprocating chillers, which are all ten years old and have a combined capacity of 540 tons. All chillers appeared to be in good condition with many years of useful life remaining. The computer simulations of this area identified that the installed capacity of 540 tons was around 28% higher than what is required to meet the building cooling loads.

The primary heating systems consisted of 14 watertube, HW boilers, which are all ten years old and have a combined capacity of 8,829 MBH. All boilers appeared to be in good condition with many years of useful life remaining. The computer simulations of this area identified that the installed capacity was approximately 4 ½ times what is required to adequately meet the building heating loads.

CHW and HW pumps are generally located within the buildings that they serve. DHW is generated by individual gas fired water heaters in each basement.

Secondary HVAC systems in these buildings consist of MZ and SZ air handling units located within the buildings. However, one building has window A/C units, a gas fired warm air furnace, and no boiler or chiller. Overall HVAC system performance in this area is poor due in part to faulty or inadequate controls, making space temperatures difficult to maintain.

Maintenance Data: Most HVAC system maintenance is performed by post civil service personnel, who maintain the central plants as well as building systems. In general, post maintenance is inadequate due to cutbacks in manpower, in conjunction with the addition of new buildings to maintain. For instance, some HVAC air filters appeared to be excessively dirty, and leaks were found in the HW coil of one air handler during data collection. Also, HVAC system controls appeared to be inoperable or missing, adding to the inability of the systems to maintain temperatures within the building spaces. Repair or replacement of these controls could save heating and cooling energy, but is beyond the scope of this study. In some buildings the outside air intakes to air handlers were blocked off with sheet metal. The existing preventative maintenance program is less effective than could be desired.

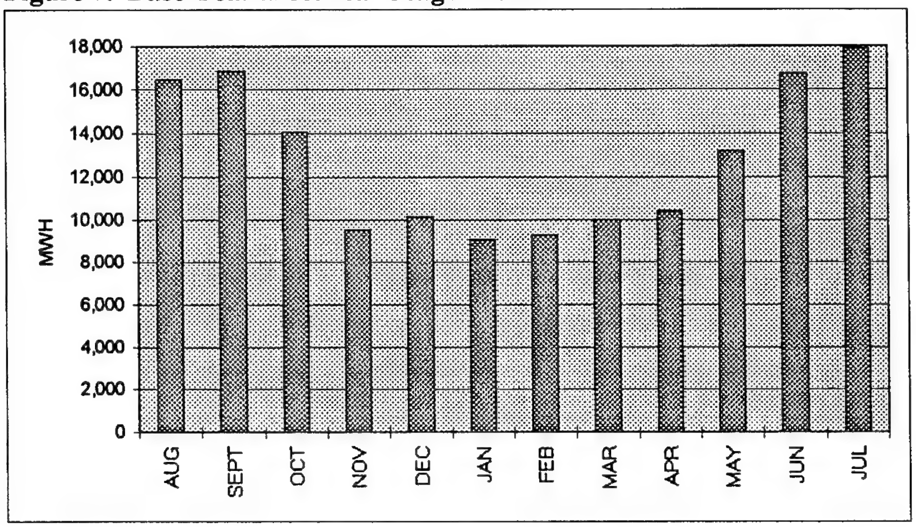
Utility Data: A 12 month utility billing history was obtained from the energy coordinator which covered the period from August, 1993 through July, 1994. This history included all of the metered electric consumption for the installation and gas consumption for only the FSH areas included in this study. This history is shown in Figure 6. The total cost of electricity for the base year was $6.5 million and the total cost for gas was $0.19 million.

Figure 6. 1993-94 Base Year Utility Data

Billing Period	Electrical			Natural Gas	
	Demand KW	Consumption MWH	Cost $	Consumption MCF	Cost $
AUG	30,576	16,464	785,463	1,826.4	7,880.0
SEPT	31,024	16,856	795,130	1,750.2	7,161.0
OCT	30,240	14,084	706,204	1,679.9	6,508.0
NOV	27,496	9,548	464,806	6,988.7	23,429.0
DEC	24,819	10,136	464,187	5,423.0	20,105.0
JAN	24,819	9,044	379,870	10,451.3	37,106.0
FEB	24,819	9,268	391,687	9,341.3	33,138.0
MAR	24,819	9,968	459,976	6,816.0	26,047.0
APR	24,819	10,416	376,714	2,177.0	9,736.0
MAY	27,160	13,216	447,478	1,750.6	7,774.0
JUN	31,752	16,716	620,912	1,519.0	6,600.0
JUL	32,872	17,864	674,674	1,691.1	7,501.0
Total	335,215	153,580	6,567,101	51,414.5	192,985

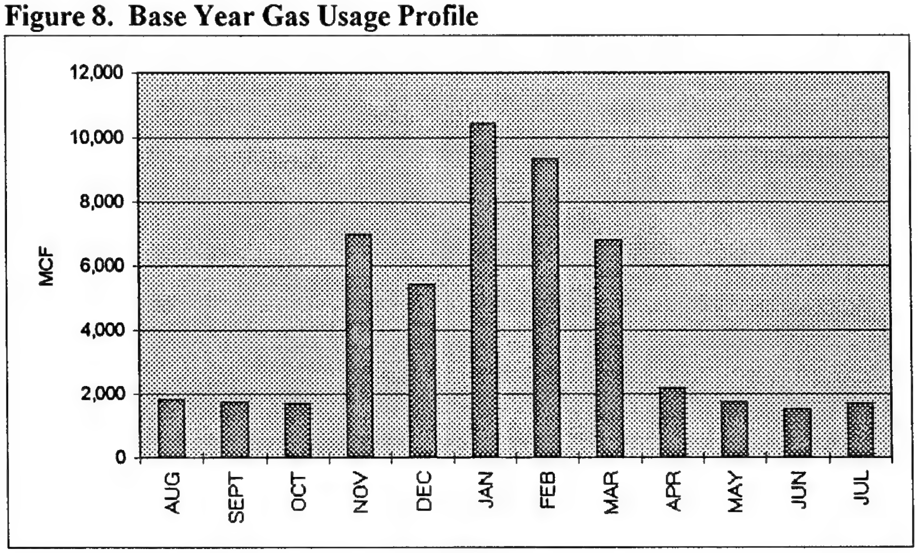
Charts of the base year energy usages were plotted and are shown in Figures 7 and 8. These charts give a visual representation of the installation's energy usage patterns for the year. Looking at Figure 7, it can be seen that the electrical usage never falls below 9,000 MWH per month. This is considered a 'baseline' of electrical energy use. It can be assumed that all energy usage above this baseline is consumed by cooling systems, based on the peaks and the months in which they occur.

Figure 7. Base Year Electrical Usage Profile



Simular observations can be made about gas energy usage, shown in Figure 8. The baseline usage here is around 1,800 MCF of gas per month. Since gas is the primary source of heating at FSH, the obvious peak during the winter months can be considered heating energy. Therefore, all gas energy usage below the baseline is used for DHW and cooking equipment. This is a large amount of energy usage and should be considered a large target for potential energy savings.

Figure 8. Base Year Gas Usage Profile



Based on the current gas and electric utility rates from the City Public Service (CPS) of San Antonio, the current avoided costs for electrical savings are $0.021 per KWH, and $7.50 to $10.00 per KW demand savings, depending upon the time of year. For natural gas savings in area 100 only, the avoided cost is $4.39 per MCF. For all other areas, the avoided cost of gas savings is $2.66 per MCF. There are currently no rebates available from the CPS for boiler or chiller energy conservation projects.

Replacement Boiler Selection: Data on available replacement boilers were obtained from typical manufacturers in order to select representative boilers for ECO evaluations. This data included performance characteristics, physical dimensions and cost figures. The criteria for selecting new boiler systems for the ECOs are described below.

1. Efficiency. Replacement boilers that had the highest overall efficiency over the operating range were selected in each area. In most cases, this criteria was met by the high-efficiency modular boilers which were modeled in the ECOs. These are fully condensing, forced draft firetube units that have efficiencies in the 90s over the entire range of operation. No other boiler type was found to match this performance.

2. Turn-down ratio. In order to limit the thermal shock and efficiency losses associated with cycling, replacement boilers for the ECOs needed to have a high turn-down ratio. The 14:1 ratio associated with the modular boilers used in most ECOs was as good or better than other available boilers with lower efficiencies. And the modular concept of using multiple boilers to match the heating loads, combined with this high turn-down ratio, minimizes the negative impacts of cycling.

3. Controls. In order to closely match the heating load requirements at any given time, all new boilers were selected with fully modulating controls. Two-position or multi-stage controls would increase the possibility of boiler cycling, as well as reduce the part load efficiency.

4. Physical size. In order to fit the new boilers into the buildings without modifying the existing boiler room openings, the small footprint and overall size of the modular boilers was the best choice for the ECOs. Other types of boilers were larger and would require more effort and cost to install in the buildings. This criteria was not a factor in areas 100 and the Quadrangle, where completely new central boiler plants were being considered.

5. First cost. The first cost of the modular boilers was greater than other types available. However, the efficiency improvements of these units justified the higher initial first costs in the Life Cycle Cost Analysis. In areas 100 and the Quadrangle, the first cost of the boilers selected was equivalent to or lower than most of the other boiler types available for the ECOs.

6. Maintenance requirements and costs. All types of replacement boilers would require annual cleaning of the heat exchanger surfaces, as well as optimization of the combustion systems. The boilers used in the ECOs appeared to be as good or better than all other boiler types in ease of maintenance. This is due to their small physical size and construction features. Maintenance cost estimates obtained from the local contractor were independent of boiler type. Therefore, all new boiler types available were assumed to be approximately equal in the area of maintenance costs.

Replacement Chiller Selection: Data on available replacement chillers were obtained from typical manufacturers in order to select representative chillers for ECO evaluations. This data included performance characteristics, physical dimensions and cost figures. The criteria for selecting new chiller systems for the ECOs are described below.

1. Manufacturer. The facility maintenance personnel requested that York chillers be used in this study as they preferred them to other manufacturer's products. Therefore, most new chillers used for analysis in the ECOs were made by York. In areas 100 and the Quadrangle, McQuay chillers were selected for reasons mentioned in the following text.

2. Machine Type. The scope of work generally identified the specific types of chillers to be compared in each area. These were the centrifugal, centrifugal with variable speed drive, screw and gas-engine driven centrifugal. Therefore, all four of these chiller types were compared in each ECO to determine the most economically beneficial retrofit for each area. In areas 100 and the Quadrangle, where new central plants were under consideration, only packaged air-cooled type chillers were considered. This was done to minimize the implementation costs in these areas.

3. Drive configuration. The new machines selected for ECO analysis all had open drives on the compressors. This increases the first cost somewhat, but decreases the long term maintenance costs.

4. Refrigerant. Replacement chillers were to all use either R-123 or R-134 refrigerant, as per the scope of work. This requirement was met in the study.

5. Efficiency. The full and part load efficiencies for all machines selected for evaluation were used in the ECOs. The relative effects of these efficiency differences are illustrated in the Life Cycle Cost Analysis of each machine. In areas 100 and the Quadrangle, the most efficient type of air cooled packaged chiller found was the single-screw unit from McQuay. Therefore, this machine was used in the ECO evaluations.

6. First cost. The first cost data for all machines selected for evaluation were used in the ECOs. The relative effects of these cost differences are illustrated in the Life Cycle Cost Analysis of each machine.

7. Maintenance requirements and costs. All types of replacement chillers would require periodic cleaning of the heat exchanger surfaces, as well as optimization of the compressor systems and controls. Maintenance cost estimates obtained from the local contractor were independent of chiller type. Therefore, all new chiller types available were assumed to be approximately equal in the area of maintenance costs.

C. Plan To Implement Projects:

The analysis of all potential boiler & chiller ECOs at the facility has been completed and the grouping of individual ECOs into projects has been determined. These were detailed previously in the Executive Summary. Below is an abbreviated plan for implementation of the recommended projects.

Funding: The forms DD-1391 and life cycle cost analysis summary sheets for all three ECIP projects are provided on pages 17 to 27. These are to be submitted for project funding, along with the savings calculations and cost estimates in Appendix D. Check for the latest ECIP project documentation requirements prior to submitting these forms. The forms DD-1391 and life cycle cost analysis summary sheets for all five Non-ECIP projects are provided on pages 28 to 42. These are to be submitted for project funding, along with the savings calculations and cost estimates in Appendix D if required. Check for the particular project documentation requirements prior to submitting these forms.

Programming: An engineering design firm should be selected to produce construction contract drawings and specifications for all of the projects which are funded either through ECIP or by other means. All of the savings calculations and cost estimates for the recommended ECOs in Appendix D should be supplied to the designers in order to inform them of the intent and projected budget of each ECO. The designers should use the equipment sizing described in the ECOs as a guide only, and perform all calculations necessary to properly size all new equipment These calculations should take into consideration all existing field conditions in the areas effected by the ECOs. It is recommended that

existing auxiliary equipment be reused wherever possible to reduce the first cost of each project. The designer should field verify the condition of all existing equipment before specifying it's disposition. In the case of boiler retrofits, the designer should consider keeping some of the existing boilers in place to be as backups. Where equipment is to be removed, the specifications should include some provisions dealing with the possible salvage value of this equipment. The facility's project manager should ensure that all new central plant designs produced by the design firm do conform with the intent of each ECO, in order to realize the estimated savings. All construction drawings and specifications should be compared to the original ECOs to ensure compliance, prior to releasing for bids.

Construction: Once the plans and specifications have been reviewed and approved, the facility's project manager should release them for bids, using their normal construction procurement proceedings. Care should be taken to schedule all work at a time which would minimize the negative impact of projects on the buildings served by the central plant equipment. Prior to construction, the facility should review all shop drawings and Submittals to once again ensure compliance with the original intent of each ECO.

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION FORT SAM HOUSTON, SAN ANTONIO, TX.	4. PROJECT TITLE ECIP

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000) 558.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace existing chiller with new centrifugal chiller in building 2265.	EA	1	237.0	237.0
Replace existing chiller with new screw chiller in building 902.	EA	1	157.0	157.0
Replace existing boilers with new high efficiency modular boilers in Area building 1377.	EA	1	164.0	164.0
ESTIMATED CONTRACT COST				500.501
CONTINGENCY (0%)				0.0
SIOH				27.527
DESIGN				30.030
TOTAL REQUEST				558.058
TOTAL REQUEST (ROUNDED)				558.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

AREA 2200:
Remove the existing 675 ton, R-11 centrifugal chiller in building 2265 and replace it with a 555 ton, R-134a centrifugal chiller. The existing 100 HP chilled water (CHW) pump, 50 HP condenser water (CND) pump and 40 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

AREA 900:
Remove the existing 300 ton, R-11 centrifugal chiller in building 902 and replace it with a 300 ton, R-134a screw chiller. The existing 25 HP chilled water (CHW) pump, 15 HP condenser water (CND) pump and 15 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE ECIP	5. PROJECT NUMBER

11. REQUIREMENT

the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

AREA 1300:
Remove the two existing watertube boilers and single 40 HP heating water (HW) distribution pump in building 1377, which are serving building 1350. Also remove the two existing firetube boilers and the two 15 HP distribution pumps in building 1377 which serve buildings 1374, 1375, 1379, 1380, 1382, 1377 and 1385. Connect the two separate distribution loops together in building 1377 with new HW supply and return headers to make a single HW distribution system. Install four new modular high efficiency boilers, rated at 1,830 MBH output each and four new 7 ½ HP distribution pumps to serve this single system. The existing electrical service and controls should be reused as much as possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180 F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

ENERGY SAVINGS

This project is required to reduce the cooling energy consumption in the 2200 and 900 area central plants, and the heating energy consumption in the 1300 area central plant. The project provides new, more efficient primary cooling and heating systems, which will save cooling and heating energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this new primary equipment will result in the following:

Electrical Energy Savings	2,450	MMBTU/yr
Electrical Demand Savings	16,189	$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	6,470	MMBTU/yr
Total Cost Savings	72,094	$/yr
Total Investment	558,058	$
Simple Payback	7.7	yrs
SIR	2.27	

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE ECIP	5. PROJECT NUMBER

11. REQUIREMENT

CURRENT SITUATION:

AREA 2200:
The existing water cooled, centrifugal chiller was installed in 1973 and serves as the primary cooling system for the four large buildings in the 2200 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already 22 years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that an electric centrifugal chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 657 tons is more than what is required to adequately cool the buildings. Therefore, the new chiller should only be sized for 555 tons to more closely match the cooling load of the four buildings.

AREA 900:
The existing water cooled, centrifugal chiller was installed in 1985 and serves as the primary cooling system for the 21 buildings in the 900 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already ten years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a dual screw chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 300 tons is required to adequately cool the buildings. Therefore, no increase or decrease in the current chiller capacity is recommended at this time.

AREA 1300:
The two existing watertube boilers serving building 1350 were installed in 1983 and are rated at 5,317 MBH and 4,336 MBH output capacity. The single 40 HP pump circulates HW from these boilers through building 1350. The two existing firetube boilers serving the other buildings in the 1300 area were installed in 1972 and are rated at 5,912 MBH output capacity each. Two 15 HP pumps circulate HW from these boilers to the seven other buildings listed above. All these boilers appear to be in fair condition. Computer simulations of the eight buildings served by these boilers determined that the current combined capacity of 21,477 MBH is about three times the amount required to adequately heat the buildings. The existing boilers are therefore

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE ECIP	5. PROJECT NUMBER

11. REQUIREMENT

operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the large boilers, excessive pumping energy is expended. By combining the two distribution systems together and staging four new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 7,320 MBH is recommended to more closely match the heating load in the eight buildings and reduce the associated pumping energy consumption.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling and heating energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECIP-3
ANALYSIS DATE: 08-24-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 500501.		
B. SIOH	$ 27527.		
C. DESIGN COST	$ 30030.		
D. TOTAL COST (1A+1B+1C)	$ 558058.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 558058.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	2450.	$ 15386.	15.08	$ 232021.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	4020.	$ 10693.	18.58	$ 198680.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 16189.	14.88	$ 240892.
N. TOTAL		6470.	$ 42268.		$ 671593.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG. UPGRADE	$ 596520.	0	1.00	596520.
d. TOTAL	$ 596520.			596520.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 596520.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 72094.

5. SIMPLE PAYBACK PERIOD (1G/4) 7.74 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 1268113.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.27
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 7.32 %

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT SAM HOUSTON, SAN ANTONIO, TX.	ECIP

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
			479.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace two (2) existing chillers in building 1377 with one (1) new chiller.	EA	1	479.0	479.0
ESTIMATED CONTRACT COST				429.768
CONTINGENCY (0%)				0.0
SIOH				23.673
DESIGN				25.786
TOTAL REQUEST				479.191
TOTAL REQUEST (ROUNDED)				479.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the two 600 ton, R-11 centrifugal chillers in building 1377 which were installed in 1972, and replace them with one R-134 centrifugal chiller, rated at 827 tons. The two existing chilled water pumps and condenser water pumps serving the existing chillers should be removed. Install a new chilled water pump and a new condenser water pump, each rated at 75 HP, to serve the new chiller. The new chiller should be connected into the distribution piping at the existing location. New chilled water supply and return headers should be installed to join together the existing distribution systems serving building 1350 and the other seven buildings in the 1300 area. This will create a single chilled water distribution system to be served by the new chiller and the existing 438 ton chiller which was installed in 1983 to serve building 1350. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and pumps, and installation of the new chillers, pumps, associated wiring and controls.

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE ECIP	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 1300 Area central plant, building 1377. The project provides a new, more efficient primary cooling system, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	3,424	MMBTU/yr
Electrical Demand Savings	13,914	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	3,424	MMBTU/yr
Total Cost Savings	56,936	$/yr
Total Investment	479,191	$
Simple Payback	8.4	yrs
SIR	1.98	

CURRENT SITUATION:

There are currently two independent chilled water distribution systems serving the 1300 area, one for building 1350 and the other for seven other buildings. These two systems should be combined into one system to conserve energy in the central plant. This can be accomplished by installing common CHW supply and return headers in the central plant. The existing centrifugal chiller serving building 1350 was installed in 1983, is rated at 438 tons and appears to be in good condition. The two existing centrifugal chillers serving the other seven buildings were installed in 1972, are rated at 600 tons each, and appear to be near the end of their useful life. Also, all three chillers use the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of these machines, they should either be retrofitted to use an approved refrigerant or replaced with new machines that operate on one. The existing centrifugal machines can be retrofitted with no loss of capacity by replacing the impellers with new ones designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the older machines are already over twenty years old, it is recommended that the facility replace them instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a single electric centrifugal chiller using R-134 would be the most economical choice over the life of the machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 1,638 tons is more than what is required to adequately cool the buildings. Therefore, the new combined capacity is recommended to be 1,265 tons to more nearly match the building cooling load.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C1
ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 429768.	
B. SIOH	$ 23637.	
C. DESIGN COST	$ 25786.	
D. TOTAL COST (1A+1B+1C)	$ 479191.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 479191.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	3424.	$ 21503.	15.08	$ 324261.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 13914.	14.88	$ 207040.
N. TOTAL		3424.	$ 35417.		$ 531301.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 2275.
(1) DISCOUNT FACTOR (TABLE A)	14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 33852.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 384882.	0	1.00	384882.
d. TOTAL	$ 384882.			384882.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 418734.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 56936.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.42 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 950035.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.98
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.59 %

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT SAM HOUSTON, SAN ANTONIO, TX.	ECIP

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
			557.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace individual building chillers with central chiller plant in Area 100.	EA	1	557.0	557.0
ESTIMATED CONTRACT COST				
CONTINGENCY (0%)				499.156
SIOH				0.0
DESIGN				27.454
				29.949
TOTAL REQUEST				
				556.559
TOTAL REQUEST (ROUNDED)				
				557.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the 14 existing air cooled, reciprocating chillers serving buildings 122, 124, 125, 128, 133, 134, 135, 142, 143, 144, 146, 147, 149, 197, 198, 199 and 250. Install 6" chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 250, near the existing air cooled chiller installation. Install two new 210 ton, air cooled screw chillers behind building 250. Install two new 30 HP chilled water distribution pumps to circulate water from new chillers through new distribution loop. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 250 to serve the new chillers and pumps. All54ER specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION

FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE ECIP	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 100 Area buildings. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	2,816	MMBTU/yr
Electrical Demand Savings	19,781	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,816	MMBTU/yr
Total Cost Savings	64,465	$/yr
Total Investment	556,559	$
Simple Payback	8.6	yrs
SIR	1.73	

CURRENT SITUATION:

The 14 existing air cooled, reciprocating chillers in the 100 area were installed in 1985 and serve as the primary cooling systems for 17 buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also greatly reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 540 tons is more than is required to adequately cool the buildings. Therefore, it is recommended that the two new chillers be rated at a combined 420 tons to more closely match the cooling load of the buildings.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-I
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 499156.		
B. SIOH	$ 27454.		
C. DESIGN COST	$ 29949.		
D. TOTAL COST (1A+1B+1C)	$ 556559.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 556559.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	2816.	$ 17684.	15.08	$ 266682.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 19781.	14.88	$ 294341.
N. TOTAL		2816.	$ 37465.		$ 561023.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 27000.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 401760.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 401760.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 64465.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.63 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 962783.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.73
(IF < 1 PROJECT DOES NOT QUALIFY)

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT SAM HOUSTON, SAN ANTONIO, TX.	

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
			237.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace existing chiller with new centrifugal chiller in building 2265.	EA	1	237.0	237.0
ESTIMATED CONTRACT COST				
CONTINGENCY (0%)				212.626
SIOH				0.0
DESIGN				11.694
				12.758
TOTAL REQUEST				
				237.078
TOTAL REQUEST (ROUNDED)				
				237.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the existing 675 ton, R-11 centrifugal chiller in building 2265 and replace it with a 555 ton, R-134a centrifugal chiller. The existing 100 HP chilled water (CHW) pump, 50 HP condenser water (CND) pump and 40 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

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1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 2200 Area central plant. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	1,304	MMBTU/yr
Electrical Demand Savings	11,822	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	1,304	MMBTU/yr
Total Cost Savings	37,433	$/yr
Total Investment	237,078	$
Simple Payback	6.3	yrs
SIR	2.73	

CURRENT SITUATION:

The existing water cooled, centrifugal chiller was installed in 1973 and serves as the primary cooling system for the four large buildings in the 2200 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already 22 years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that an electric centrifugal chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 657 tons is more than what is required to adequately cool the buildings. Therefore, the new chiller should only be sized for 555 tons to more closely match the cooling load of the four buildings.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E1
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 212626.		
B. SIOH	$ 11694.		
C. DESIGN COST	$ 12758.		
D. TOTAL COST (1A+1B+1C)	$ 237078.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 237078.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	1304.	$ 8189.	15.08	$ 123492.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 11822.	14.88	$ 175911.
N. TOTAL		1304.	$ 20011.		$ 299403.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 348435.	0	1.00	348435.
d. TOTAL	$ 348435.			348435.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 348435.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 37433.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.33 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 647838.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.73
(IF < 1 PROJECT DOES NOT QUALIFY)

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION FORT SAM HOUSTON, SAN ANTONIO, TX.	4. PROJECT TITLE

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000) 157.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace existing chiller with new screw chiller in building 902.	EA	1	157.0	157.0
ESTIMATED CONTRACT COST				
CONTINGENCY (0%)				141.037
SIOH				0.0
DESIGN				7.757
				8.462
TOTAL REQUEST				
				157.256
TOTAL REQUEST (ROUNDED)				
				157.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the existing 300 ton, R-11 centrifugal chiller in building 902 and replace it with a 300 ton, R-134a screw chiller. The existing 25 HP chilled water (CHW) pump, 15 HP condenser water (CND) pump and 15 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 900 Area central plant. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	434	MMBTU/yr
Electrical Demand Savings	2,520	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	434	MMBTU/yr
Total Cost Savings	17,650	$/yr
Total Investment	157,256	$
Simple Payback	8.9	yrs
SIR	2.08	

CURRENT SITUATION:

The existing water cooled, centrifugal chiller was installed in 1985 and serves as the primary cooling system for the 21 buildings in the 900 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the machine is already ten years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a dual screw chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 300 tons is required to adequately cool the buildings. Therefore, no increase or decrease in the current chiller capacity is recommended at this time.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A3
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 141037.			
B. SIOH	$ 7757.			
C. DESIGN COST	$ 8462.			
D. TOTAL COST (1A+1B+1C)	$ 157256.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 157256.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	434.	$ 2726.	15.08	$ 41101.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 2520.	14.88	$ 37498.
N. TOTAL		434.	$ 5246.		$ 78598.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 248085.	0	1.00	248085.
d. TOTAL	$ 248085.			248085.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 248085.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 17650.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.91 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 326683.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.08
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

1. COMPONENT		2. DATE
ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	8/24/95

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT SAM HOUSTON, SAN ANTONIO, TX.	

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
			479.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace two (2) existing chillers in building 1377 with one (1) new chiller.	EA	1	479.0	479.0
ESTIMATED CONTRACT COST				429.768
CONTINGENCY (0%)				0.0
SIOH				23.673
DESIGN				25.786
TOTAL REQUEST				479.191
TOTAL REQUEST (ROUNDED)				479.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the two 600 ton, R-11 centrifugal chillers in building 1377 which were installed in 1972, and replace them with one R-134 centrifugal chiller, rated at 827 tons. The two existing chilled water pumps and condenser water pumps serving the existing chillers should be removed. Install a new chilled water pump and a new condenser water pump, each rated at 75 HP, to serve the new chiller. The new chiller should be connected into the distribution piping at the existing location. New chilled water supply and return headers should be installed to join together the existing distribution systems serving building 1350 and the other seven buildings in the 1300 area. This will create a single chilled water distribution system to be served by the new chiller and the existing 438 ton chiller which was installed in 1983 to serve building 1350. All existing controls and electrical services should be reconnected where possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and pumps, and installation of the new chillers, pumps, associated wiring and controls.

DD FORM 1 DEC 76 1391

PAGE NO. 1 of 2

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 1300 Area central plant, building 1377. The project provides a new, more efficient primary cooling system, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	3,424	MMBTU/yr
Electrical Demand Savings	13,914	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	3,424	MMBTU/yr
Total Cost Savings	56,936	$/yr
Total Investment	479,191	$
Simple Payback	8.4	yrs
SIR	1.98	

CURRENT SITUATION:

There are currently two independent chilled water distribution systems serving the 1300 area, one for building 1350 and the other for seven other buildings. These two systems should be combined into one system to conserve energy in the central plant. This can be accomplished by installing common CHW supply and return headers in the central plant. The existing centrifugal chiller serving building 1350 was installed in 1983, is rated at 438 tons and appears to be in good condition. The two existing centrifugal chillers serving the other seven buildings were installed in 1972, are rated at 600 tons each, and appear to be near the end of their useful life. Also, all three chillers use the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996. To avoid the anticipated increasing operational costs over the life of these machines, they should either be retrofitted to use an approved refrigerant or replaced with new machines that operate on one. The existing centrifugal machines can be retrofitted with no loss of capacity by replacing the impellers with new ones designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates. However, since the older machines are already over twenty years old, it is recommended that the facility replace them instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a single electric centrifugal chiller using R-134 would be the most economical choice over the life of the machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 1,638 tons is more than what is required to adequately cool the buildings. Therefore, the new combined capacity is recommended to be 1,265 tons to more nearly match the building cooling load.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C1
ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 429768.		
B. SIOH	$ 23637.		
C. DESIGN COST	$ 25786.		
D. TOTAL COST (1A+1B+1C)	$ 479191.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 479191.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	3424.	$ 21503.	15.08	$ 324261.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 13914.	14.88	$ 207040.
N. TOTAL		3424.	$ 35417.		$ 531301.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2275.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 33852.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 384882.	0	1.00	384882.
d. TOTAL	$ 384882.			384882.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 418734.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 56936.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.42 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 950035.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.98
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.59 %

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT SAM HOUSTON, SAN ANTONIO, TX.	

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
			164.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace existing boilers with new high efficiency modular boilers in building 1377.	EA	1	164.0	164.0
ESTIMATED CONTRACT COST				
CONTINGENCY (0%)				146.838
SIOH				0.0
DESIGN				8.076
				8.810
TOTAL REQUEST				163.724
TOTAL REQUEST (ROUNDED)				164.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the two existing watertube boilers and single 40 HP heating water (HW) distribution pump in building 1377, which are serving building 1350. Also remove the two existing firetube boilers and the two 15 HP distribution pumps in building 1377 which serve buildings 1374, 1375, 1379, 1380, 1382, 1377 and 1385. Connect the two separate distribution loops together in building 1377 with new HW supply and return headers to make a single HW distribution system. Install four new modular high efficiency boilers, rated at 1,830 MBH output each and four new 7 ½ HP distribution pumps to serve this single system. The existing electrical service and controls should be reused as much as possible. Specific requirements in all areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180 F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the heating energy consumption in the 1300 Area central plant. The project provides new, more efficient primary heating systems, which will save heating energy and cost. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	712	MMBTU/yr
Electrical Demand Savings	1,847	$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	4,732	MMBTU/yr
Total Cost Savings	17,012	$/yr
Total Investment	163,724	$
Simple Payback	9.6	yrs
SIR	1.79	

CURRENT SITUATION:

The two existing watertube boilers serving building 1350 were installed in 1983 and are rated at 5,317 MBH and 4,336 MBH output capacity. The single 40 HP pump circulates HW from these boilers through building 1350. The two existing firetube boilers serving the other buildings in the 1300 area were installed in 1972 and are rated at 5,912 MBH output capacity each. Two 15 HP pumps circulate HW from these boilers to the seven other buildings listed above. All these boilers appear to be in fair condition. Computer simulations of the eight buildings served by these boilers determined that the current combined capacity of 21,477 MBH is about three times the amount required to adequately heat the buildings. The existing boilers are therefore operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the large boilers, excessive pumping energy is expended. By combining the two distribution systems together and staging four new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 7,320 MBH is recommended to more closely match the heating load in the eight buildings and reduce the associated pumping energy consumption.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in heating energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-D
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 146838.		
B. SIOH	$ 8076.		
C. DESIGN COST	$ 8810.		
D. TOTAL COST (1A+1B+1C)	$ 163724.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 163724.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	712.	$ 4471.	15.08	$ 67428.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	4020.	$ 10693.	18.58	$ 198680.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 1847.	14.88	$ 27483.
N. TOTAL		4732.	$ 17012.		$ 293591.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 17012.

5. SIMPLE PAYBACK PERIOD (1G/4) 9.62 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 293591.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.79
(IF < 1 PROJECT DOES NOT QUALIFY)

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
FORT SAM HOUSTON, SAN ANTONIO, TX.	

5. PROGRAM ELEMENT	6. CATAGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
			557.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Replace individual building chillers with central chiller plant in Area 100.	EA	1	557.0	557.0
ESTIMATED CONTRACT COST				
CONTINGENCY (0%)				499.156
SIOH				0.0
DESIGN				27.454
				29.949
TOTAL REQUEST				556.559
TOTAL REQUEST (ROUNDED)				557.000

10. DESCRIPTION OF PROPOSED CONSTRUCTION

Remove the 14 existing air cooled, reciprocating chillers serving buildings 122, 124, 125, 128, 133, 134, 135, 142, 143, 144, 146, 147, 149, 197, 198, 199 and 250. Install 6" chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 250, near the existing air cooled chiller installation. Install two new 210 ton, air cooled screw chillers behind building 250. Install two new 30 HP chilled water distribution pumps to circulate water from new chillers through new distribution loop. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 250 to serve the new chillers and pumps. All54ER specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

DD FORM 1 DEC 76 1391

1. COMPONENT ARMY	FY 1997 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 8/24/95

3. INSTALLATION AND LOCATION
FORT SAM HOUSTON, SAN ANTONIO, TX.

4. PROJECT TITLE	5. PROJECT NUMBER

11. REQUIREMENT

This project is required to reduce the cooling energy consumption in the 100 Area buildings. The project provides new, more efficient primary cooling systems, which will save cooling energy and cost. Additionally, this project will help protect the environment by replacing equipment which uses an ozone depleting refrigerant. All buildings included in this project will be active throughout the payback period. Installation of this cooling equipment will result in the following:

Electrical Energy Savings	2,816	MMBTU/yr
Electrical Demand Savings	19,781	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,816	MMBTU/yr
Total Cost Savings	64,465	$/yr
Total Investment	556,559	$
Simple Payback	8.6	yrs
SIR	1.73	

CURRENT SITUATION:

The 14 existing air cooled, reciprocating chillers in the 100 area were installed in 1985 and serve as the primary cooling systems for 17 buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also greatly reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 540 tons is more than is required to adequately cool the buildings. Therefore, it is recommended that the two new chillers be rated at a combined 420 tons to more closely match the cooling load of the buildings.

IMPACT IF NOT PROVIDED

If this project is not provided, the above mentioned savings in cooling energy and cost will continue to be wasted. There will be no contribution to the energy reduction goals established at the facility.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-I
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT
A. CONSTRUCTION COST $ 499156.
B. SIOH $ 27454.
C. DESIGN COST $ 29949.
D. TOTAL COST (1A+1B+1C) $ 556559.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 556559.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	2816.	$ 17684.	15.08	$ 266682.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 19781.	14.88	$ 294341.
N. TOTAL		2816.	$ 37465.		$ 561023.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 27000.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 401760.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 401760.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 64465.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.63 YEA

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 962783.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.73
(IF < 1 PROJECT DOES NOT QUALIFY)

APPENDIX A

ENERGY COST ANALYSIS

APPENDIX A
ENERGY COST ANALYSIS

TABLE OF CONTENTS

APPENDIX A
ENERGY COST ANALYSIS

A. Electrical Energy Cost Analysis

Electrical Rate Schedule: The post purchases it's electrical power from the City Public Service (CPS) of San Antonio, and is billed under the Super Large Power (SLP) rate. Service is provided through a single substation on the post, owned by the Army. The SLP rate has been in effect since January of 1994, and was created by the utility company to lower military base charges, thereby helping to avoid base closures. This rate has resulted in substantial cost decreases, even though the electrical usage on the post has increased. The monthly SLP billing rate components are as follows:

Service Availability Charge:	\$1,000	
Energy Charge:	\$0.024/KWH	
Demand Charge:	\$10.00/KW billing demand \$7.50/KW billing demand	(June through September) (October through May)
where:	billing demand is the highest 15 minute metered KW demand during the month, or 5000 KW, or 80% of highest billing demand from previous June through September (applicable only from October through May), whichever is greatest	
Fuel Cost Adjustment:	calculated monthly, difference between actual fuel cost and \$0.016/KWH (average variance from base year data is -\$0.002566/KWH)	

Avoided Costs: In order to convert electric demand and energy savings into dollar savings, the avoided costs of demand and energy are determined. These are the marginal cost savings to be realized by the post, per unit of demand or energy saved. Using the above billing components, the *Avoided Cost of Demand* (C_{SD} & C_{WD}) and the *Avoided Cost of Energy* (C_E) are determined as follows:

$$C_{SD} = \frac{\$10.00}{KW} \quad (June\ through\ September)$$

$$C_{WD} = \frac{\$7.50}{KW} \quad (October\ through\ May)$$

$$C_E = (E + F) \, x \, \frac{KWH}{3413\ BTU} \, x \, \frac{1{,}000{,}000\ BTU}{MMBTU} \qquad \frac{\$}{MMBTU}$$

$$C_E = (0.024 - 0.002566)\ x\ \frac{1{,}000{,}000}{3413} = \frac{\$6.28}{MMBTU}$$

Rebate Program: The City Public Service of San Antonio currently offers no cash incentives for energy conservation retrofits.

B. Natural Gas Energy Cost Analysis

Gas Rate Schedules: FSH is currently supplied natural gas by CPS through many meters distributed throughout the post. However, the meters serving areas 900, 1300, 2200 and the quadrangle are all billed under the Large Volume Gas (LVG) rate. The monthly LVG billing rate components are as follows:

Service Availability Charge: $325

Energy Charge: $2.65/MCF

Fuel Adjustment: calculated monthly, difference between actual gas cost and $2.20/MCF (average variance from base year data is $0.0142/MCF)

Demand Charge: $0.080/(MCF/day) (December through March)
$0.064/(MCF/day) (April through November)

where: billing demand is the monthly gas consumption (MCF) divided by the number of days in the month, or 60 MCF/day, or the maximum billing demand established during the period of December through March (applicable only during April through November), whichever is greatest

The buildings in the area 100 have individual gas meters and are billed under the Residential Gas (RG) rate #4. The monthly RG billing rate components are as follows:

Service Availability Charge: $3.85

Energy Charge: $4.38/MCF

Fuel Adjustment: calculated monthly, difference between actual gas cost and $2.20/MCF (average variance from base year data is $0.0142/MCF)

Avoided Costs: In order to convert gas energy savings or penalties into cost savings or penalties, the *Avoided Cost of Gas* (C_G) is determined for each rate schedule described above as follows:

Areas 900, 1300, 2200 and Quadrangle,

$$C_G = (E + F) \times \frac{1\ MCF}{MMBTU} \qquad \frac{\$}{MMBTU}$$

where,

E = energy charge = $2.65 per MCF
F = fuel adjustment = $0.0142 per MCF (average from base year data)

$$C_G = (2.65 + 0.0142) = 2.66 \ \frac{\$}{MMBTU}$$

Area 100,

$$C_G = (E + F) \times \frac{1\ MCF}{MMBTU} \qquad \frac{\$}{MMBTU}$$

where,

E = energy charge = $4.38 per MCF
F = fuel adjustment = $0.0142 per MCF (average from base year data)

$$C_G = (4.38 + 0.0142) = 4.39 \ \frac{\$}{MMBTU}$$

APPENDIX B

COMPUTER MODELING OF BOILER & CHILLER SYSTEMS

APPENDIX B
COMPUTER MODELING OF BOILER & CHILLER SYSTEMS

TABLE OF CONTENTS

APPENDIX B
COMPUTER MODELING OF BOILER & CHILLER SYSTEMS

A. General Parameters. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.

1. The Trace 600 weather data for San Antonio, Texas was used in all of the computer simulations.

2. The Trace 600 computer simulations were performed for the months of January through December to determine annual HVAC equipment energy consumptions.

3. A special holiday schedule was created to incorporate the additional holidays that military personnel living in the area 900 and 1300 barracks buildings receive. This schedule includes the seven standard holidays plus the period from December 17 through 31. The standard seven day holiday schedule was used for all other areas.

4. All building dimensions and construction data were determined from as-built drawings when available, or from field measurements taken during the site visit.

5. Design room temperatures (thermostat setpoints) were obtained from CEMP-E (9 December 1991) Chapter 13, Section 3. These temperatures were 78°F for cooling and 70°F for heating. No cooling or heating temperature setback control was included in the simulations.

6. The shading coefficient for all windows with interior blinds was estimated at 0.67 per ASHRAE data.

7. The number of people in each building or room was estimated from interviews with post personnel. The sensible and latent heat gain rates used for the people in each room were taken from ASHRAE data.

8. Building and room lighting loads were obtained from as-built drawings when available, or from field notes taken during the site visit.

9. Building and room miscellaneous equipment loads were estimated from field notes taken during the site visit. These loads represent the internal heat gains generated from equipment in the rooms, such as computers, televisions, cooking equipment, etc. Heat gain data for the various types of internal loads was taken from ASHRAE.

10. For all building areas with forced ventilation, the rates were taken from ASHRAE Standard 62-1989 or from schedule data on the existing air handlers, whichever was greater.

11. For all barracks buildings with operable windows and no forced ventilation, infiltration rates were assumed to be equal to building or room exhaust rates.

12. Building and room exhaust rates were taken from as-built drawings.

B. People, Lights and Miscellaneous Equipment Schedules. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.

1. Offices and Classrooms: During the weekdays, all people, lights and miscellaneous equipment were scheduled at 100% from 8 am until 12 pm, and from 1 pm until 5 pm. During the lunch hour, from 12 pm until 1 pm, all internal loads were scheduled at 10%. On the weekends and holidays, all loads were scheduled at 0%.

2. Barracks:

   a. People - During the weekdays, all people were scheduled at 5% between 8 am and 5 pm. Between 5 pm and 10 pm, they were scheduled at 80%, and between 10 pm and 8 am, they were scheduled at 100%. During the weekends and holidays, the people were scheduled at 50% all day long.

   b. Lights and Miscellaneous Equipment - During the weekdays, the lights and miscellaneous equipment (TVs, radios, etc.) were scheduled at 5% between 8 am and 5 pm. Between 5 pm and 10 pm, they were scheduled at 80%, and between 10 pm and 8 am, they were scheduled at 5%. During the weekends and holidays, the lights and miscellaneous equipment were scheduled at 50% from 8 am until 10 pm, and 5% from 10 pm until 8 am.

3. Dining Areas:

   a. People - During the weekdays, weekends and holidays, all people were scheduled at 100% between 6 am and 9 am, between 11 am and 2 pm, and between 5 pm and 7 pm. They were scheduled at 0% at all other times.

   b. Lights and Miscellaneous Equipment - During the weekdays, weekends and holidays, all lights and miscellaneous equipment were scheduled at 100% between 5 am and 7 pm. They were scheduled at 0% at all other times.

4. Kitchen Areas: During the weekdays, weekends and holidays, all people, lights and miscellaneous equipment were scheduled at 100% from 4 am until 9 pm. They were scheduled at 0% at all other times.

C. HVAC Equipment Schedules. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.

1. All fan coil and air handler fans were scheduled to operate 100% of the day, 12 months of the year, as required by room thermostats to maintain building setpoint temperatures.

2. All fan coil and air handler cooling coils were scheduled to operate 100% of the day, from May through October, as required by room thermostats to maintain building setpoint temperatures.

3. All fan coil and air handler heating coils were scheduled to operate 100% of the day, from November through April, as required by room thermostats to maintain building setpoint temperatures.

4. All building infiltration and ventilation air is scheduled to be introduced into the buildings at a fixed rate 100% of the day, 12 months per year.

5. All building and room thermostats were scheduled to maintain the design setpoints 24 hours per day, 12 months per year with no setback periods.

D. Building HVAC Systems. The following assumptions and estimates were used in the modeling of the existing buildings which are served by the boilers and chillers included in this study.

1. HVAC air system types were taken from building as-built drawings when available, or from field notes taken during the site visit.

2. In order to simplify the calculations, most buildings were modeled as a single 'zone' served by a single HVAC air system. Other buildings with more diverse occupancies were zoned as shown on as-built drawings and served by individual HVAC air systems in order to generate a more realistic load profile for the boilers and chillers.

3. Each building HVAC air system was assumed to have a chilled water coil for cooling and a heating water coil for heating. These coils were assumed to be served by two-pipe distribution systems within the buildings.

E. Boiler & Chiller Systems. The following assumptions and estimates were used in the modeling of the boiler and chiller systems included in this study.

1. Existing boiler and chiller systems types were identified during the field inspection and used in the computer simulations. They're full load capacity and energy consumption rates were input to match the existing systems. The Trace 600 models were used for part load performance of the existing boilers and chillers.

2. It was assumed that all existing chillers had a full load KW/ton increase of 1% over their original rating for each year of service up to ten years. For all service over ten years, 0.25% per year was added to the full load KW/ton rating. This was done to account for natural efficiency losses due to tube fouling and compressor wear.

3. It was assumed that all existing boilers had a full load efficiency decrease of 1% under their original rating for each year of service up to ten years. For all service over ten years, 0.25% per year was deducted from the full load efficiency rating. This was done to account for natural efficiency losses due to tube fouling and burner wear.

4. The existing pumping horsepower for all associated pumps was also input to simulate the existing systems.

5. In area 900, a base load of 565 MBH per hour was imposed on the existing and proposed boilers to account for the generation of domestic hot water in the barracks buildings. This base load increases the required boiler capacity and shows up as 'base utility' in the equipment energy consumption output sheets.

6. Proposed boiler and chiller alternatives were selected for comparison in the computer simulations. Full load capacity and energy consumption rates were obtained from manufacturer's data and input into the computer simulations. When available, part load energy consumption data from the manufactures was used in the simulations.

7. All new chillers were selected from the top 25% of their class in terms of efficiency (KW/ton), and also were at least 10% more efficient than current design standards.

8. New pumping horsepower for all associated pumps was estimated for all proposed boilers and chillers and input to simulate the new systems.

9. Existing cooling tower systems were identified during the field inspection and used in the computer simulations. They're existing fan horsepower was also input to simulate the existing towers.

10. In all areas, a base load was added to the chillers and boilers to account for heat loss or gain from circulating pumps and piping insulation. These base loads increased the required capacity of the boilers and chillers and show up as 'base utility' in the equipment energy consumption output sheets.

01 Card - Job Information

Project: 030185.04 EEAP BOILER-CHILLER STUDY
Location: FT. SAM HOUSTON - SAN ANTONIO, TX.
Client: CORPS. OF ENGINEERS - FORT WORTH, TX.
Program User: HUITT-ZOLLARS INC.
Comments: AREA 900

Card 08--------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
SANANTON								

Card 11--------- Energy Simulation Parameters -----------------

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
			ARMY1994		

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	EXISTING BUILDINGS

Card 20--- General Room Parameters ---

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
5	5	BLDG 904	103	103	3	0	2.54	9.5			
10	10	BLDG 907	103	103	3	0	2.54	9.5			
15	15	BLDG 920	103	103	3	0	2.54	9.5			
20	20	BLDG 926	103	103	3	0	2.54	9.5			
25	25	BLDG 915	103	103	3	0	2.54	9.5			
30	30	BLDG 921	103	103	3	0	2.54	9.5			
35	35	BLDG 929	103	103	3	0	2.54	9.5			
40	40	BLDG 932	103	103	3	0	2.54	9.5			
45	45	BLDG 905	103	103	3	0	2.54	9.5			

Card 20 ---------- General Room Parameters ----------

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
50	50	BLDG 906	103	103	3	0	2.54	9.5			
55	55	BLDG 924	103	103	3	0	2.54	9.5			
60	60	BLDG 925	103	103	3	0	2.54	9.5			
65	65	BLDG 916	103	103	3	0	2.54	9.5			
70	70	BLDG 917	103	103	3	0	2.54	9.5			
75	75	BLDG 930	103	103	3	0	2.54	9.5			
80	80	BLDG 931	103	103	3	0	2.54	9.5			
85	85	BLDG 908	46	46	3	1.5	2.54	10			
90	90	BLDG 919	46	46	3	1.5	2.54	10			
95	95	BLDG 922	46	46	3	1.5	2.54	10			
100	100	BLDG 928	46	46	3	1.5	2.54	10			
105	105	BLDG 902	136	137	3	4	2.54	13			

Card 21 ---------- Thermostat Parameters ----------

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
5	78	50	78		70	70		ROOM	LIGHT30	NO
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO
25	78	50	78		70	70		ROOM	LIGHT30	NO
30	78	50	78		70	70		ROOM	LIGHT30	NO
35	78	50	78		70	70		ROOM	LIGHT30	NO
40	78	50	78		70	70		ROOM	LIGHT30	NO
45	78	50	78		70	70		ROOM	LIGHT30	NO
50	78	50	78		70	70		ROOM	LIGHT30	NO
55	78	50	78		70	70		ROOM	LIGHT30	NO
60	78	50	78		70	70		ROOM	LIGHT30	NO
65	78	50	78		70	70		ROOM	LIGHT30	NO
70	78	50	78		70	70		ROOM	LIGHT30	NO
75	78	50	78		70	70		ROOM	LIGHT30	NO
80	78	50	78		70	70		ROOM	LIGHT30	NO
85	78	50	78		70	70		ROOM	LIGHT30	NO
90	78	50	78		70	70		ROOM	LIGHT30	NO
95	78	50	78		70	70		ROOM	LIGHT30	NO
100	78	50	78		70	70		ROOM	LIGHT30	NO
105	78	50	78		70	70		ROOM	LIGHT30	NO

Card 22 ---------- Roof Parameters ----------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
5	1		59	60	.08	26	0	90	.74

Card 22------------------------- Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
10	1		59	60	.08	26	0	90	.74
15	1		59	60	.08	26	0	90	.74
20	1		59	60	.08	26	0	90	.74
25	1		59	60	.08	26	0	90	.74
30	1		59	60	.08	26	0	90	.74
35	1		59	60	.08	26	0	90	.74
40	1		59	60	.08	26	0	90	.74
45	1		59	60	.08	26	0	90	.74
50	1		59	60	.08	26	0	90	.74
55	1		59	60	.08	26	0	90	.74
60	1		59	60	.08	26	0	90	.74
65	1		59	60	.08	26	0	90	.74
70	1		59	60	.08	26	0	90	.74
75	1		59	60	.08	26	0	90	.74
80	1		59	60	.08	26	0	90	.74
85	1	YES			.07	48	0	90	.9
90	1	YES			.07	48	0	90	.9
95	1	YES			.07	48	0	90	.9
100	1	YES			.07	48	0	90	.9
105	1	YES			.07	48	0	90	.9

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
5	1	275	9.5	.11	58	0		.74	
5	2	108	9.5	.11	58	90		.74	
5	3	275	9.5	.11	58	180		.74	
5	4	108	9.5	.11	58	270		.74	
10	1	275	9.5	.11	58	0		.74	
10	2	108	9.5	.11	58	90		.74	
10	3	275	9.5	.11	58	180		.74	
10	4	108	9.5	.11	58	270		.74	
15	1	275	9.5	.11	58	0		.74	
15	2	108	9.5	.11	58	90		.74	
15	3	275	9.5	.11	58	180		.74	
15	4	108	9.5	.11	58	270		.74	
20	1	275	9.5	.11	58	0		.74	
20	2	108	9.5	.11	58	90		.74	
20	3	275	9.5	.11	58	180		.74	
20	4	108	9.5	.11	58	270		.74	
25	1	275	9.5	.11	58	0		.74	
25	2	108	9.5	.11	58	90		.74	
25	3	275	9.5	.11	58	180		.74	

Card 24--------------------------- Wall Parameters ---------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
25	4	108	9.5	.11	58	270		.74	
30	1	275	9.5	.11	58	0		.74	
30	2	108	9.5	.11	58	90		.74	
30	3	275	9.5	.11	58	180		.74	
30	4	108	9.5	.11	58	270		.74	
35	1	275	9.5	.11	58	0		.74	
35	2	108	9.5	.11	58	90		.74	
35	3	275	9.5	.11	58	180		.74	
35	4	108	9.5	.11	58	270		.74	
40	1	275	9.5	.11	58	90		.74	
40	2	108	9.5	.11	58	180		.74	
40	3	275	9.5	.11	58	270		.74	
40	4	108	9.5	.11	58	0		.74	
45	1	275	9.5	.11	58	90		.74	
45	2	108	9.5	.11	58	180		.74	
45	3	275	9.5	.11	58	270		.74	
45	4	108	9.5	.11	58	0		.74	
50	1	275	9.5	.11	58	90		.74	
50	2	108	9.5	.11	58	180		.74	
50	3	275	9.5	.11	58	270		.74	
50	4	108	9.5	.11	58	0		.74	
55	1	275	9.5	.11	58	90		.74	
55	2	108	9.5	.11	58	180		.74	
55	3	275	9.5	.11	58	270		.74	
55	4	108	9.5	.11	58	0		.74	
60	1	275	9.5	.11	58	90		.74	
60	2	108	9.5	.11	58	180		.74	
60	3	275	9.5	.11	58	270		.74	
60	4	108	9.5	.11	58	0		.74	
65	1	275	9.5	.11	58	90		.74	
65	2	108	9.5	.11	58	180		.74	
65	3	275	9.5	.11	58	270		.74	
65	4	108	9.5	.11	58	0		.74	
70	1	275	9.5	.11	58	90		.74	
70	2	108	9.5	.11	58	180		.74	
70	3	275	9.5	.11	58	270		.74	
70	4	108	9.5	.11	58	0		.74	
75	1	275	9.5	.11	58	90		.74	
75	2	108	9.5	.11	58	180		.74	
75	3	275	9.5	.11	58	270		.74	
75	4	108	9.5	.11	58	0		.74	
80	1	275	9.5	.11	58	90		.74	
80	2	108	9.5	.11	58	180		.74	
80	3	275	9.5	.11	58	270		.74	
80	4	108	9.5	.11	58	0		.74	
85	1	46	10	.10	58	0		.74	
85	2	46	10	.10	58	90		.74	

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
85	3	46	10	.10	58	180		.74	
85	4	46	10	.10	58	270		.74	
90	1	46	10	.10	58	0		.74	
90	2	46	10	.10	58	90		.74	
90	3	46	10	.10	58	180		.74	
90	4	46	10	.10	58	270		.74	
95	1	46	10	.10	58	0		.74	
95	2	46	10	.10	58	90		.74	
95	3	46	10	.10	58	180		.74	
95	4	46	10	.10	58	270		.74	
100	1	46	10	.10	58	0		.74	
100	2	46	10	.10	58	90		.74	
100	3	46	10	.10	58	180		.74	
100	4	46	10	.10	58	270		.74	
105	1	188	13	.21	52	0		.9	
105	2	188	13	.21	52	180		.9	
105	3	125	13	.21	52	270		.9	

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
10	1	4	2	54	1.1	.67					
10	3	4	2	54	1.1	.67					
15	1	4	2	54	1.1	.67					
15	3	4	2	54	1.1	.67					
20	1	4	2	54	1.1	.67					
20	3	4	2	54	1.1	.67					
25	1	4	2	54	1.1	.67					
25	3	4	2	54	1.1	.67					
30	1	4	2	54	1.1	.67					
35	3	4	2	54	1.1	.67					
40	1	4	2	54	1.1	.67					
45	3	4	2	54	1.1	.67					
50	1	4	2	54	1.1	.67					
50	3	4	2	54	1.1	.67					
55	1	4	2	54	1.1	.67					
55	3	4	2	54	1.1	.67					
60	1	4	2	54	1.1	.67					
60	3	4	2	54	1.1	.67					
65	1	4	2	54	1.1	.67					
65	3	4	2	54	1.1	.67					
70	1	4	2	54	1.1	.67					
70	3	4	2	54	1.1	.67					
75	1	4	2	54	1.1	.67					

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
75	3	4	2	54	1.1	.67					
80	1	4	2	54	1.1	.67					
80	3	4	2	54	1.1	.67					
85	1	8	10	1	1.1	.67					
85	2	8	4	2	1.1	.67	3				
85	4	8	4	2	1.1	.67	3				
90	1	8	10	1	1.1	.67	3				
90	2	8	4	2	1.1	.67	3				
90	4	8	4	2	1.1	.67	3				
95	1	8	10	1	1.1	.67	3				
95	2	8	4	2	1.1	.67	3				
95	4	8	4	2	1.1	.67	3				
100	1	8	10	1	1.1	.67	3				
100	2	8	4	2	1.1	.67	3				
100	4	8	4	2	1.1	.67	3				
105	1	2	4	7	1.1	.67					
105	2	2	4	7	1.1	.67					
105	3	2	4	2	1.1	.67					

Card 26-- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
5	FSHBARRP	FSHBARRL								
10	FSHBARRP	FSHBARRL								
15	FSHBARRP	FSHBARRL								
20	FSHBARRP	FSHBARRL								
25	FSHBARRP	FSHBARRL								
30	FSHBARRP	FSHBARRL								
35	FSHBARRP	FSHBARRL								
40	FSHBARRP	FSHBARRL								
45	FSHBARRP	FSHBARRL								
50	FSHBARRP	FSHBARRL								
55	FSHBARRP	FSHBARRL								
60	FSHBARRP	FSHBARRL								
65	FSHBARRP	FSHBARRL								
70	FSHBARRP	FSHBARRL								
75	FSHBARRP	FSHBARRL								
80	FSHBARRP	FSHBARRL								
85	FSHOFFIC	FSHOFFIC								
90	FSHOFFIC	FSHOFFIC								
95	FSHBARRP	FSHBARRL								
100	FSHBARRP	FSHBARRL								
105	FSHOFFIC	FSHOFFIC								

Card 27------------------------------------ People and Lights --

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
5	53	PEOPLE	250	200	1	WATT-SF	INCAND				
10	53	PEOPLE	250	200	1	WATT-SF	INCAND				
15	53	PEOPLE	250	200	1	WATT-SF	INCAND				
20	53	PEOPLE	250	200	1	WATT-SF	INCAND				
25	53	PEOPLE	250	200	1	WATT-SF	INCAND				
30	53	PEOPLE	250	200	1	WATT-SF	INCAND				
35	53	PEOPLE	250	200	1	WATT-SF	INCAND				
40	53	PEOPLE	250	200	1	WATT-SF	INCAND				
45	53	PEOPLE	250	200	1	WATT-SF	INCAND				
50	53	PEOPLE	250	200	1	WATT-SF	INCAND				
55	53	PEOPLE	250	200	1	WATT-SF	INCAND				
60	53	PEOPLE	250	200	1	WATT-SF	INCAND				
65	53	PEOPLE	250	200	1	WATT-SF	INCAND				
70	53	PEOPLE	250	200	1	WATT-SF	INCAND				
75	53	PEOPLE	250	200	1	WATT-SF	INCAND				
80	53	PEOPLE	250	200	1	WATT-SF	INCAND				
85	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
90	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
95	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
100	10	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
105	96	PEOPLE	250	200	2.75	WATT-SF	ASHRAE2				

Card 28-- Miscellaneous Equipment --

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
5	1	BARREQ	.75	WATT-SF	FSHBARRL						
10	1	BARREQ	.75	WATT-SF	FSHBARRL						
15	1	BARREQ	.75	WATT-SF	FSHBARRL						
20	1	BARREQ	.75	WATT-SF	FSHBARRL						
25	1	BARREQ	.75	WATT-SF	FSHBARRL						
30	1	BARREQ	.75	WATT-SF	FSHBARRL						
35	1	BARREQ	.75	WATT-SF	FSHBARRL						
40	1	BARREQ	.75	WATT-SF	FSHBARRL						
45	1	BARREQ	.75	WATT-SF	FSHBARRL						
50	1	BARREQ	.75	WATT-SF	FSHBARRL						
55	1	BARREQ	.75	WATT-SF	FSHBARRL						
60	1	BARREQ	.75	WATT-SF	FSHBARRL						
65	1	BARREQ	.75	WATT-SF	FSHBARRL						
70	1	BARREQ	.75	WATT-SF	FSHBARRL						
75	1	BARREQ	.75	WATT-SF	FSHBARRL						
80	1	BARREQ	.75	WATT-SF	FSHBARRL						
85	1	COMPUTER	1	WATT-SF	FSHOFFIC						
90	1	COMPUTER	1	WATT-SF	FSHOFFIC						
95	1	COMPUTER	1	WATT-SF	FSHBARRL						
100	1	COMPUTER	1	WATT-SF	FSHBARRL						
105	1	COMPUTER	1	WATT-SF	FSHOFFIC						

Card 29---------- Room Airflows ----------

Room Number	Ventilation Cooling Value	Ventilation Cooling Units	Ventilation Heating Value	Ventilation Heating Units	Infiltration Cooling Value	Infiltration Cooling Units	Infiltration Heating Value	Infiltration Heating Units	Reheat Minimum Value	Reheat Minimum Units
5					1440	CFM	1440	CFM		
10					1440	CFM	1440	CFM		
15					1440	CFM	1440	CFM		
20					1440	CFM	1440	CFM		
25					1440	CFM	1440	CFM		
30					1440	CFM	1440	CFM		
35					1440	CFM	1440	CFM		
40					1440	CFM	1440	CFM		
45					1440	CFM	1440	CFM		
50					1440	CFM	1440	CFM		
55					1440	CFM	1440	CFM		
60					1440	CFM	1440	CFM		
65					1440	CFM	1440	CFM		
70					1440	CFM	1440	CFM		
75					1440	CFM	1440	CFM		
80					1440	CFM	1440	CFM		
85	340	CFM	340	CFM						
90	340	CFM	340	CFM						
95	340	CFM	340	CFM						
100	340	CFM	340	CFM						
105	3580	CFM	3580	CFM						

Card 30---------- Fan Airflows ----------

Room Number	Main Cooling Value	Main Cooling Units	Main Heating Value	Main Heating Units	Auxiliary Cooling Value	Auxiliary Cooling Units	Auxiliary Heating Value	Auxiliary Heating Units	Room Exhaust Value	Room Exhaust Units
5									1440	CFM
10									1440	CFM
15									1440	CFM
20									1440	CFM
25									1440	CFM
30									1440	CFM
35									1440	CFM
40									1440	CFM
45									1440	CFM
50									1440	CFM
55									1440	CFM
60									1440	CFM
65									1440	CFM
70									1440	CFM
75									1440	CFM
80									1440	CFM
85									325	CFM
90									325	CFM
95									325	CFM

Card 30---------------------------------- Fan Airflows --

	---------------Main---------------				------------Auxiliary-----------					
Room	----Cooling----		----Heating----		----Cooling----		----Heating----		--Room Exhaust--	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
100									325	CFM
105									850	CFM

Card 31-------------------------- Partition Parameters -----------------------------------

Room Number	Partition Number	Partition Length	Partition Height	Partition U-Value	Const Type	Temp Flag	Cooling Temp	Heating Temp	Adjacent Room No
105	1	125	13	.09	101	HRLYOADB			

Card 33-------------------------------- External Shading --------------------------------------

	---------OVERHANG---------			--------------------VERTICAL FINS--------------------					
Shading Type	Glass Height	Height Above Glass	Projection Out	Glass Width	Projection Left	Left Projection Out	Projection Right	Right Projection Out	Adjacent Building Flag
3	8	1	7	4	.5	7	.5	7	

-------------------- System Section Alternative #1 --------------------

Card 39- System Alternative

Number	Description
1	EXISTING BUILDINGS

Card 40---------------------- System Type -----------------------------

		------------OPTIONAL VENTILATION SYSTEM------------					
System Set Number	System Type	Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
1	FC						

Card 41--------------------------------------- Zone Assignment ---

System	Ref #1		Ref #2		Ref #3		Ref #4		Ref #5		Ref #6	
Set Number	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End
1	5	105										

Card 42----------------------- Fan SP and Duct Parameters-----------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	.75	.75									

Card 45----------------------------------- Equipment Schedules --

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

-------------------- Equipment Section Alternative #1 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60--- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001S	1	304	TONS	225	KW							

Card 63----------------------------- Cooling Pumps and References ---------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	18.65	KW	11.19	KW					1	

Card 65-------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End

Card 67------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	900HEXIS	1	3.73	KW	1665	MBH	2250	MBH	1			1		
2	900HEXIS	1			1665	MBH	2250	MBH	2					
3	900HEXIS	1			1665	MBH	2250	MBH	3					

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	DHW USE-LINE LOS	608.2	MBH	AVAIL	HOT-LD	1			
2	HT-PUMP LOSS CHL	33.4	TONS	FTSAMCLG	CHILL-LD	1			

Card 74--------------------------- Condenser / Cooling Tower Parameters -------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			11.19	KW			1			

Card 75------------------------------------- Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5013	3.73	KW		EQ5013	1.49	KW		EQ5013	1.12	KW	

-------------------- Equipment Section Alternative #2 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				GAS ENGINE DRIVEN CHILLER, EXIST. BOILER		

Card 60-- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YENGDRIV	1			1980	MBH							

Card 63----------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	18.65	KW	11.19	KW					1	

Card 71--------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	HT-PUMP LOSS CHL	33.4	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			11.19	KW			1			

-------------------- Equipment Section Alternative #3 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				WATER COOLED SCREW CHILLER, EXIST BOILER		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	--COOLING-- --Capacity-- Value	Units	----Energy---- Value	Units	--HEAT RECOVERY-- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YSCRW22	1			186	KW							

Card 63----------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	18.65	KW	11.19	KW					1	

Card 71--------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	HT-PUMP LOSS CHL	33.4	TONS	FTSAHCLG	CHILL-LD	1			

Card 74----------------------------- Condenser / Cooling Tower Parameters -------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			11.19	KW			1			

-------------------- Equipment Section Alternative #4 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
4				W. C. R-123 CENTR. CHILLER, EXIST BOILER		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YCENT123	1			177	KW							

Card 63----------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	18.65	KW	11.19	KW					1	

Card 71--------------------------------- Base Utility Parameters --------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	HT-PUMP LOSS CHL	33.4	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			11.19	KW			1			

Card 42---------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	.75	.75									

Card 45------------------------------------ Equipment Schedules --

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin End	-Group 2- Begin End	-Group 3- Begin End	-Group 4- Begin End	-Group 5- Begin End	-Group 6- Begin End	-Group 7- Begin End	-Group 8- Begin End	-Group 9- Begin End
1	1	BLKPLANT	1 1								

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001S	1	304	TONS	225	KW							

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	18.65	KW	11.19	KW					1	

Card 65--- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin End	-Group 2- Begin End	-Group 3- Begin End	-Group 4- Begin End	-Group 5- Begin End	-Group 6- Begin End	-Group 7- Begin End	-Group 8- Begin End	-Group 9- Begin End

Card 67-------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	900HEXIS	1	3.73	KW	1665	MBH	2250	MBH	1			1		
2	900HEXIS	1			1665	MBH	2250	MBH	2					
3	900HEXIS	1			1665	MBH	2250	MBH	3					

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	DHW USE-LINE LOS	608.2	MBH	AVAIL	HOT-LD	1			
2	HT-PUMP LOSS CHL	33.4	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			11.19	KW			1			

Card 75-------------------------------------- Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5013	3.73	KW		EQ5013	1.49	KW		EQ5013	1.12	KW	

-------------------- Equipment Section Alternative #2 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ---------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				EXIST CHILLER, FORCE DRAFT HIGH BOILER		

Card 65--------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																

Card 67-------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	BOILHEFT	1	3.73	KW	1758	MBH	2000	MBH				1		

Card 71---------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	DHW USE-LINE LOS	608.2	MBH	AVAIL	HOT-LD	1			

Card 75-------------------------------------- Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5013	3.73	KW		EQ5013	1.49	KW		EQ5013	1.12	KW	

-------------------- Equipment Section Alternative #3 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				W. C. V.F.D. CENTR. CHILLER, EXIST BOILR		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62----------------------------------- Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YCENVFD	1			177	KW							

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	18.65	KW	11.19	KW					1	

Card 71--------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	HT-PUMP LOSS CHL	33.4	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			11.19	KW			1			

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**   **
**   T R A C E   6 0 0   A N A L Y S I S   **
**   **
**   by HUITT & ZOLLARS   **
**   **
****
****

030185.04 EEAP BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS. OF ENGINEERS - FORT WORTH, TX.
HUITT-ZOLLARS INC.
AREA 900

Weather File Code:		
Location:	SAN ANTONIO, TEXAS	
Latitude:	29.0	(deg)
Longitude:	98.0	(deg)
Time Zone:	6	
Elevation:	792	(ft)
Barometric Pressure:	29.0	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	97	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	30	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0738	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0818	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,761.9	(Btu-min./hr/cuft)
Enthalpy Factor:	4.4255	(Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 14:25:17 5/31/95
Dataset Name: FSH900 .TM

STEM TOTALS LOAD PROFILE - ALTERNATIVE 1
..ISTING BUILDINGS

-- S Y S T E M   L O A D   P R O F I L E --

System Totals

Percent Design Load	---- Cooling Load ---- Cap. (Ton)	Hours (%)	Hours	------ Heating Load ------ Capacity (Btuh)	Hours (%)	Hours
0 - 5	15.5	7	276	-127,751	41	728
5 - 10	31.0	8	317	-255,502	24	432
10 - 15	46.5	8	313	-383,253	11	199
15 - 20	62.0	7	288	-511,003	8	146
20 - 25	77.5	8	307	-638,754	5	89
25 - 30	93.0	9	353	-766,505	4	79
30 - 35	108.5	6	257	-894,256	4	76
35 - 40	124.0	4	168	-1,022,007	1	16
40 - 45	139.5	5	202	$\boxed{-1,149,758}$	1	16
45 - 50	155.0	4	173	-1,277,509	0	0
50 - 55	170.5	5	207	-1,405,259	0	0
55 - 60	186.0	6	235	-1,533,010	0	0
60 - 65	201.5	5	188	-1,660,761	0	0
65 - 70	217.0	4	143	-1,788,512	0	0
- 75	232.5	3	124	-1,916,263	0	0
75 - 80	247.9	4	147	-2,044,014	0	0
80 - 85	$\boxed{263.4}$	8	332	-2,171,765	0	0
85 - 90	278.9	0	0	-2,299,516	0	0
90 - 95	294.4	0	0	-2,427,266	0	0
95 - 100	309.9	0	0	-2,555,017	0	0
Hours Off	0.0	0	4,730	0	0	6,979

JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
_ASE CASE

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	HOTLD	4525	4087	4525	4379	4525	4379	4525	4525	4379	4525	4379	4525	53,278
	PK	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
2		BASE UTILITY												
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,494
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33.4
1	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	62585	78816	95844	100025	69899	36888	0	0	$\boxed{444,056}$
	PK	0.0	0.0	0.0	0.0	202.4	202.7	223.5	225.8	208.0	115.8	0.0	0.0	225.8
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4420	0	0	$\boxed{45,510}$
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2

JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
ASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	337	432	526	544	381	183	0	0	2,403
	PK	0.0	0.0	0.0	0.0	1.2	1.1	1.2	1.2	1.1	0.7	0.0	0.0	1.2
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1		NATURAL DRAFT, WATER TUBE BOILER												
	GAS	7875	7951	6205	5921	6115	5918	6115	6115	5918	6115	6024	7815	78,086
	PK	19.1	22.5	10.2	8.8	8.2	8.2	8.2	8.2	8.2	8.2	10.1	19.7	22.5
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
1	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	93	90	93	93	90	93	90	93	1,095
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	1109	1001	1109	1073	1109	1073	1109	1109	1073	1109	1073	1109	13,052
	PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	833	753	833	806	833	806	833	833	806	833	806	833	9,811
	PK	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
2		NATURAL DRAFT, WATER TUBE BOILER												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

IPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
S ENGINE DRIVEN CHILLER, EXIST. BOILER

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,494
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33.4
1		YORK ENGINE DRIVEN CHILLER												
	GAS	0	0	0	0	4756	5968	7287	7671	5326	2853	0	0	33,862
	PK	0.0	0.0	0.0	0.0	16.1	15.6	18.7	19.6	16.0	8.1	0.0	0.0	19.6
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4262	0	0	45,352
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	365	467	569	591	412	200	0	0	2,604
	PK	0.0	0.0	0.0	0.0	1.3	1.2	1.4	1.4	1.2	0.8	0.0	0.0	1.4

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
.3 ENGINE DRIVEN CHILLER, EXIST. BOILER

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011			CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)										
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

UIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
ER COOLED SCREW CHILLER, EXIST BOILER

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,494
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33.4
1	YSCRW22		YORK W.C. SCREW CHILL.											
	ELEC	0	0	0	0	44600	56032	67754	70890	48770	28993	0	0	317,039
	PK	0.0	0.0	0.0	0.0	163.7	150.3	176.9	184.9	154.6	76.2	0.0	0.0	184.9
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4354	0	0	45,444
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	320	411	501	518	361	175	0	0	2,287
	PK	0.0	0.0	0.0	0.0	1.2	1.1	1.2	1.2	1.1	0.7	0.0	0.0	1.2

"QUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
/ER COOLED SCREW CHILLER, EXIST BOILER

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011	CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

'IPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
. C. R-123 CENTR. CHILLER, EXIST BOILER

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,494
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33.4
1		YORK CENT. R-123 CHILLER												
	ELEC	0	0	0	0	45712	56332	67955	70957	50302	28814	0	0	320,072
	PK	0.0	0.0	0.0	0.0	155.7	143.0	168.4	175.9	147.1	80.7	0.0	0.0	175.9
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4351	0	0	45,441
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	321	411	501	518	363	175	0	0	2,290
	PK	0.0	0.0	0.0	0.0	1.2	1.1	1.2	1.2	1.1	0.7	0.0	0.0	1.2

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
C. R-123 CENTR. CHILLER, EXIST BOILER

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		------------	------------	------------	------------	Monthly Consumption	------------	------------	------------	------------	------------	------------	------------	
1	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011			CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)										
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	49,415
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
. C. V.F.D. CENTR. CHILLER, EXIST BOILR

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	24850	24048	24850	24850	24048	24850	0	0	147,494
	PK	0.0	0.0	0.0	0.0	33.4	33.4	33.4	33.4	33.4	33.4	0.0	0.0	33.4
1	YCENVFD	YORK TURBO MODULATOR VAR. FREQ. DRIVE												
	ELEC	0	0	0	0	40210	51150	62895	66342	45212	23500	0	0	289,309
	PK	0.0	0.0	0.0	0.0	144.1	138.0	166.7	175.3	141.8	69.5	0.0	0.0	175.3
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	4311	0	0	45,401
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	316	407	496	514	358	170	0	0	2,262
	PK	0.0	0.0	0.0	0.0	1.2	1.0	1.2	1.2	1.1	0.7	0.0	0.0	1.2

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
. C. V.F.D. CENTR. CHILLER, EXIST BOILR

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	$\boxed{82,358}$
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
1	EQ5011	CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)												
	ELEC	0	0	0	0	8325	8057	8325	8325	8057	8325	0	0	$\boxed{49,415}$
	PK	0.0	0.0	0.0	0.0	11.2	11.2	11.2	11.2	11.2	11.2	0.0	0.0	11.2
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

IPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
IST CHILLER, FORCE DRAFT HIGH % BOILER

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	42784	38686	42866	41391	42825	41473	42743	42866	41391	42825	41473	42375	503,698
	PK	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0	152.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1				BASE UTILITY										
	HOTLD	4525	4087	4525	4379	4525	4379	4525	4525	4379	4525	4379	4525	53,278
	PK	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1
1				HIGH EFFICIENCY MODULAR FIRETUBE BOIL.										
	GAS	6629	6694	5224	4985	5148	4982	5148	5148	4982	5148	5071	6579	65,738
	PK	16.1	19.2	8.6	7.4	6.9	6.9	6.9	6.9	6.9	6.9	8.5	16.6	19.2
1	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
1	EQ5311			BOILER CONTROLS										
	ELEC	93	84	93	90	93	90	93	93	90	93	90	93	1,095
	PK	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

!IPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
_..IST CHILLER, FORCE DRAFT HIGH % BOILER

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	2775	2507	2775	2686	2775	2686	2775	2775	2686	2775	2686	2775	32,675
	PK	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	1109	1001	1109	1073	1109	1073	1109	1109	1073	1109	1073	1109	13,052
	PK	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	833	753	833	806	833	806	833	833	806	833	806	833	9,811
	PK	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1

01 Card - Job Information

Project: 03018504 BOILER-CHILLER STUDY
Location: FT. SAM HOUSTON - SAN ANTONIO, TX.
Client: CORPS OF ENGINEERS - FT. WORTH, TEXAS
Program User: HUITT - ZOLLARS INC.
Comments: AREA 1300

Card 08 — Climatic Information

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
SANANTON								

Card 11 — Energy Simulation Parameters

1st Month Energy Simulation	Last Month Energy Simulation	Level Of Calculation	Holiday Code	Calendar Code	Building Floor Area
			ARMY1994		

Load Section Alternative #1

Card 19- Load Alternative -

Number	Description
1	AREA 1300 EXISTING BUILDINGS

Card 20 — General Room Parameters

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
5	5	ADMIN 1350	179	180	3	3	2.54	12.5			
10	10	DINING 1350	107	108	3	3	2.54	12.5			
15	15	KITCHEN 1350	69	69	3	3	2.54	12.5			
20	20	BARR 1350	398	399	3	3	2.54	12.5			
25	25	ADMIN 1374	100	100	3	4	2.54	13			
30	30	BARR 1374	240	240	3	4	2.54	13			
35	35	ADMIN 1375	100	100	3	4	2.54	13			
40	40	BARR 1375	240	240	3	4	2.54	13			
45	45	ADMIN 1379	100	100	3	4	2.54	13			

Card 20---------- General Room Parameters ----------

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
50	50	BARR 1379	240	240	3	4	2.54	13			
55	55	ADMIN 1380	100	100	3	4	2.54	13			
60	60	BARR 1380	240	240	3	4	2.54	13			
65	65	BLDG. 1385	82	62	3	3.5	2.54	12			
70	70	ADMIN 1382	60	60	3	4	2.54	12			
75	75	BARR 1382	161	161	3	2	2.54	10.5			
80	80	KITCH 1377	100	100	3	3	2.54	12			
85	85	DIN 1377	116	116	3	3	2.54	12			

Card 21---------- Thermostat Parameters ----------

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
5	78	50	78		70	70		ROOM	LIGHT30	YES
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO
25	78	50	78		70	70		ROOM	LIGHT30	NO
30	78	50	78		70	70		ROOM	LIGHT30	NO
35	78	50	78		70	70		ROOM	LIGHT30	NO
40	78	50	78		70	70		ROOM	LIGHT30	NO
45	78	50	78		70	70		ROOM	LIGHT30	NO
50	78	50	78		70	70		ROOM	LIGHT30	NO
55	78	50	78		70	70		ROOM	LIGHT30	NO
60	78	50	78		70	70		ROOM	LIGHT30	NO
65	78	50	78		70	70		ROOM	LIGHT30	NO
70	78	50	78		70	70		ROOM	LIGHT30	NO
75	78	50	78		70	70		ROOM	LIGHT30	NO
80	78	50	78		70	70		ROOM	LIGHT30	NO
85	78	50	78		70	70		ROOM	LIGHT30	NO

Card 22---------- Roof Parameters ----------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
5	1	NO	164	163	0.05	21			
10	1	YES			0.05	21			
15	1	YES			0.05	21			
20	1	NO	282	282	0.05	21			
25	1	NO	88	30	0.07	43			
30	1	NO	164	164	0.07	43			
35	1	NO	88	30	0.07	43			
40	1	NO	164	164	0.07	43			

Card 22------------------------ Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
45	1	NO	88	30	.07	43			
50	1	NO	164	164	0.07	43			
55	1	NO	83	30	0.07	43			
60	1	NO	164	164	0.07	43			
65	1	YES			0.08	47			
70	1	YES			0.07	37			
75	1	NO	114	114	0.07	37			
80	1	YES			0.11	47			
85	1	YES			0.11	47			

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
5	1	128	12.5	.15	29	0			
20	1	1130	12.5	.15	29	0			
20	2	1400	12.5	.15	29	90			
20	3	1130	12.5	.15	29	180			
20	4	1400	12.5	.15	29	270			
25	1	88	13	.15	94	180			
25	2	40	13	.20	61	270			
25	3	40	13	.20	61	90			
30	1	912	13	.13	80	180		.74	
30	2	768	13	.13	80	270		.74	
30	3	912	13	.13	80	0		.74	
30	4	768	13	.13	80	90		.74	
35	1	88	13	.15	94	180			
35	2	40	13	.20	61	270			
35	3	40	13	.20	61	90			
40	1	912	13	.13	80	180		.74	
40	2	768	13	.13	80	270		.74	
40	3	912	13	.13	80	0		.74	
40	4	768	13	.13	80	90		.74	
45	1	88	13	.15	94	0			
45	2	40	13	.20	61	90			
45	3	40	13	.20	61	270			
50	1	912	13	.13	80	0		.74	
50	2	768	13	.13	80	90		.74	
50	3	912	13	.13	80	180		.74	
50	4	768	13	.13	80	270		.74	
55	1	88	13	.15	94	0			
55	2	40	13	.20	61	90			
55	3	40	13	.20	61	270			
60	1	912	13	.13	80	0		.74	
60	2	768	13	.13	80	90		.74	

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
60	3	912	13	.13	80	180		.74	
60	4	768	13	.13	80	270		.74	
65	1	82	12	.22	58	0			
65	2	62	12	.22	58	90			
65	3	82	12	.22	58	180			
65	4	62	12	.22	58	270			
70	1	44	12	.22	58	0			
70	2	52	12	.22	58	90			
70	3	68	12	.22	58	270			
75	1	360	10.5	.22	58	0			
75	2	312	10.5	.22	58	90			
75	3	412	10.5	.22	58	180			
75	4	312	10.5	.22	58	270			
80	1	62	12	.10	58	90			
80	2	32	12	.10	58	270			
85	1	82	12	.10	58	0			
85	2	160	12	.10	58	90			
85	3	82	12	.10	58	180			
85	4	124	12	.10	58	270			

Card 25--- Wall/Glass Parameters ---

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
5	1	4	5.5	12	.73	1					
20	1	4	5.5	272	.73	1	3				
20	2	4	5.5	84	.73	1	3				
20	3	4	5.5	272	.73	1	3				
20	4	4	5.5	84	.73	1	3				
25	1	4	7	16	1.1	.67	4				
30	1	2	4	144	1.1	.67	4				
30	2	2	4	72	1.1	.67	4				
30	3	2	4	116	1.1	.67	4				
30	4	2	4	72	1.1	.67	4				
35	1	4	7	16	1.1	.67	4				
40	1	2	4	144	1.1	.67	4				
40	2	2	4	72	1.1	.67	4				
40	3	2	4	116	1.1	.67	4				
40	4	2	4	72	1.1	.67	4				
45	1	4	7	16	1.1	.67	4				
50	1	2	4	144	1.1	.67	4				
50	2	2	4	72	1.1	.67	4				
50	3	2	4	116	1.1	.67	4				
50	4	2	4	72	1.1	.67	4				
55	1	4	7	16	1.1	.67	4				

Card 25--- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
60	1	2	4	144	1.1	.67	4				
60	2	2	4	72	1.1	.67	4				
60	3	2	4	116	1.1	.67	4				
60	4	2	4	72	1.1	.67	4				
65	1	4	4	8	1.1	1	5				
65	2	4	4	8	1.1	1	5				
65	3	4	4	6	1.1	1	5				
65	4	4	4	8	1.1	1	5				
70	1	5	3	7	1.1	1					
70	2	5	3	1	1.1	1					
75	1	6	3	23	1.1	1					
75	2	6	3	16	1.1	1					
75	3	6	3	24	1.1	1					
75	4	6	3	14	1.1	1					
85	2	5	5	6	1.1	1					
85	4	5	5	6	1.1	1					

Card 26--- Schedules ---

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
5	FSHOFFIC	FSHOFFIC								
10	FSHDINP	FSHDINL								
15	FSHKITCH	FSHKITCH								
20	FSHBARRP	FSHBARRL								
25	FSHOFFIC	FSHOFFIC								
30	FSHBARRP	FSHBARRL								
35	FSHOFFIC	FSHOFFIC								
40	FSHBARRP	FSHBARRL								
45	FSHOFFIC	FSHOFFIC								
50	FSHBARRP	FSHBARRP								
55	FSHOFFIC	FSHOFFIC								
60	FSHBARRP	FSHBARRL								
65	FSHOFFIC	FSHOFFIC								
70	FSHOFFIC	FSHOFFIC								
75	FSHBARRP	FSHBARRL								
80	FSHKITCH	FSHKITCH								
85	FSHDINP	FSHDINL								

Card 27------------------------------------- People and Lights ---

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
5	175	SF-PERS	250	200	2.25	WATT-SF	ASHRAE2				

Card 27------------------------------------ People and Lights ---

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
10	300	PEOPLE	275	275	1.7	WATT-SF	ASHRAE2				
15	20	PEOPLE	275	475	1.5	WATT-SF	ASHRAE2				
20	1538	PEOPLE	250	200	1	WATT-SF	ASHRAE2				
25	35	SF-PERS	250	200	3.5	WATT-SF	ASHRAE2				
30	420	PEOPLE	250	200	2.6	WATT-SF	SUSINCAN				
35	35	SF-PERS	250	200	3.5	WATT-SF	ASHRAE2				
40	420	PEOPLE	250	200	2.6	WATT-SF	SUSINCAN				
45	35	SF-PERS	250	200	3.5	WATT-SF	ASHRAE2				
50	420	PEOPLE	250	200	2.6	WATT-SF	SUSINCAN				
55	35	SF-PERS	250	200	3.5	WATT-SF	ASHRAE2				
60	420	PEOPLE	250	200	2.6	WATT-SF	SUSINCAN				
65	16	PEOPLE	250	200	2.0	WATT-SF	ASHRAE2				
70	8	PEOPLE	250	200	3.0	WATT-SF	ASHRAE2				
75	232	PEOPLE	250	200	.65	WATT-SF	ASHRAE2				
80	30	PEOPLE	250	200	2.6	WATT-SF	ASHRAE2				
85	800	PEOPLE	250	200	1.22	WATT-SF	ASHRAE2				

Card 28-- Miscellaneous Equipment ---

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
5	1	COMPUTER	1	WATT-SF	FSHOFFIC						
10	1	DIN. EQPT.	1	WATT-SF	FSHDINL						
15	1	KITCHEN	16	WATT-SF	FSHKITCH						
20	1	TV ETC.	1	WATT-SF	FSHBARRL						
25	1	COMPUTER	1	WATT-SF	FSHOFFIC						
30	1	PERS APP.	.5	WATT-SF	FSHBARRL						
35	1	COMPUTER	1	WATT-SF	FSHOFFIC						
40	1	PERS APP.	.5	WATT-SF	FSHBARRL						
45	1	COMPUTER	1	WATT-SF	FSHOFFIC						
50	1	PERS APP.	.5	WATT-SF	FSHBARRL						
55	1	COMPUTER	1	WATT-SF	FSHOFFIC						
60	1	PERS APP.	.5	WATT-SF	FSHBARRL						
65	1	COMPUTER	1	WATT-SF	FSHOFFIC						
70	1	COMPUTER	1	WATT-SF	FSHOFFIC						
75	1	PERS APP.	.5	WATT-SF	FSHBARRL						
80	1	KITCHEN	16	WATT-SF	FSHKITCH						
85	1	DINING	1	WATT-SF	FSHDINL						

Card 29-- Room Airflows --

Room Number	-------------Ventilation------------- -----Cooling----- Value	Units	-----Heating----- Value	Units	-------------Infiltration------------ -----Cooling----- Value	Units	-----Heating----- Value	Units	--Reheat Minimum-- Value	Units
5	3975	CFM	3975	CFM						

Card 29-- Room Airflows --

Room Number	Ventilation Cooling Value	Ventilation Cooling Units	Ventilation Heating Value	Ventilation Heating Units	Infiltration Cooling Value	Infiltration Cooling Units	Infiltration Heating Value	Infiltration Heating Units	Reheat Minimum Value	Reheat Minimum Units
10	20	CFM-P	20	CFM-P						
15	3000	CFM	3000	CFM						
20	17385	CFM	17385	CFM						
25	7700	CFM	7700	CFM						
30	12000	CFM	12000	CFM						
35	7700	CFM	7700	CFM						
40	12000	CFM	12000	CFM						
45	7700	CFM	7700	CFM						
50	12000	CFM	12000	CFM						
55	7700	CFM	7700	CFM						
60	12000	CFM	12000	CFM						
65	900	CFM	900	CFM						
70	20	CFM-P	20	CFM-P						
75	20	CFM-P	20	CFM-P						
80	12700	CFM	12700	CFM						
85	12200	CFM	12200	CFM						

Card 31-------------------------- Partition Parameters ------------------------------------

Room Number	Partition Number	Partition Length	Partition Height	Partition U-Value	Const Type	Temp Flag	Cooling Temp	Heating Temp	Adjacent Room No
5	1	264	12.5	.23	103	HRLYOADB			
5	2	264	12.5	.23	103	HRLYOADB			
5	3	680	12.5	.15	103	HRLYOADB			
10	1	220	12.5	.44	107	HRLYOADB			
25	1	244	13	.20	107	HRLYOADB			
30	1	244	13	.20	107	HRLYOADB			
35	1	244	13	.20	107	HRLYOADB			
40	1	244	13	.20	107	HRLYOADB			
45	1	244	13	.20	107	HRLYOADB			
50	1	244	13	.20	107	HRLYOADB			
55	1	244	13	.20	107	HRLYOADB			
60	1	244	13	.20	107	HRLYOADB			
80	1	30	12	.10	107	HRLYOADB			

Card 33-------------------------------- External Shading --------------------------------------

Shading Type	Overhang: Glass Height	Overhang: Height Above Glass	Overhang: Projection Out	Vertical Fins: Glass Width	Vertical Fins: Projection Left	Vertical Fins: Left Projection Out	Vertical Fins: Projection Right	Vertical Fins: Right Projection Out	Adjacent Building Flag
3	5.5	1	2						
4	4	1	5						
5	4	1	3						

-------------------- System Section Alternative #1 --------------------

Card 39- System Alternative

Number	Description
1	EXISTING SYSTEM

Card 40---------------------- System Type -----------------------------

------------OPTIONAL VENTILATION SYSTEM------------

System Set Number	System Type	Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
1	VAV						
2	MZ						

Card 41-------------------------------------- Zone Assignment ---

System Set Number	Ref #1 Begin	Ref #1 End	Ref #2 Begin	Ref #2 End	Ref #3 Begin	Ref #3 End	Ref #4 Begin	Ref #4 End	Ref #5 Begin	Ref #5 End	Ref #6 Begin	Ref #6 End
1	5	20										
2	25	85										

Card 42---------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	1.5	1.5									
2	1.5	1.5									

Card 45------------------------------------ Equipment Schedules --

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
2	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																
2	2	BLKPLANT	2	2																

Card 62------------------------------------ Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001S	1	438	TONS	329	KW							
2	EQ1001S	1	544	TONS	517	KW					1	SER	
3	EQ1001S	1	442	TONS	517	KW					2	SER	

Card 63---------------------------- Cooling Pumps and References ---------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	29.84	KW	22.38	KW					1	
2	18.65	KW	29.84	KW					2	2
3			29.84	KW					2	

Card 65-- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																
2	3	2	2																

Card 67--------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	1350HWB1	1	29.84	KW	5317	MBH	7500	MBH	1					
2	1350HWB2	1			4336	MBH	5800	MBH	2					
3	1300HWHB	1	11.19	KW	5912	MBH	8369	MBH	1			1		
4	1300HWHB	1	11.19	KW	5912	MBH	8369	MBH	2			3		

Card 71---------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	19.45	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOSS	482.9	MBH	FTSAMHTG	HOT-LD	1			
3	PIPE-PUMP HT LOS	45.56	TONS	FTSAMCLG	CHILL-LD	2			
4	PIPE HT LOSS	1312.5	MBH	FTSAMHTG	HOT-LD	3			

Card 74----------------------------- Condenser / Cooling Tower Parameters ---------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	EQ5100			52.22	KW			2			

Card 75-------------------------------------- Miscellaneous Accessory ---

Misc Ref	#1 Equip Code	#1 Energy Value	#1 Energy Units	#1 Sched Code	#2 Equip Code	#2 Energy Value	#2 Energy Units	#2 Sched Code	#3 Equip Code	#3 Energy Value	#3 Energy Units	#3 Sched Code
1	EQ5020	11.19	KW		EQ5240	7.46	KW					
2	EQ5001	18.65	KW									
3	EQ5240	7.46	KW									

-------------------- Equipment Section Alternative #2 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				EXISTING CHILLERS, HIGH MODULAR BOILRS		

Card 65--------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	2																

Card 67--------------------------------------- Heating Equipment Parameters ---

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	BOILHEFT	1	5.6	KW	1830	MBH	2000	MBH	1					

Card 67------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
2	BOILHEFT	1	5.6	KW	1830	MBH	2000	MBH	2					
3	BOILHEFT	1	5.6	KW	1830	MBH	2000	MBH	3					
4	BOILHEFT	1	5.6	KW	1830	MBH	2000	MBH	4					

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE HT LOSS	1795.4	MBH	FTSAMHTG	HOT-LD	1			

-------------------- Equipment Section Alternative #3 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				WATER COOLED CENTR. CHILLER, EXIST BOILR		

Card 60--- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	2																

Card 62----------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YCENT134	1	425	TONS	264	KW					1	PAR	
2	YCENT134	1	840	TONS	487	KW					2	PAR	

Card 63--------------------------- Cooling Pumps and References ---------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	29.84	KW	29.84	KW			1		1	

Card 63------------------------------ Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
2	55.95	KW	55.95	KW			1		2	

Card 71---------------------------------- Base Utility Parameters --------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	22	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE-PUMP HT LOS	43	TONS	FTSAMCLG	CHILL-LD	2			

Card 72-- Switchover Controls ---------

Control Reference	Load Value	Load Units	Outside Air DB	Sched Code
1	425	TONS		

Card 74----------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	EQ5100			52.2	KW			2			

-------------------- Equipment Section Alternative #4 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
4				WAT. COOLED DUAL SCREW CHILR, EXIST BLR		

Card 60-- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	2																

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING Capacity Value	COOLING Capacity Units	COOLING Energy Value	COOLING Energy Units	HEAT RECOVERY Capacity Value	HEAT RECOVERY Capacity Units	HEAT RECOVERY Energy Value	HEAT RECOVERY Energy Units	Seq Order Num	Seq Type	Demand Limit Number
1	YSCRW22	1	425	TONS	272	KW					1	PAR	
2	YSCRW22	1	840	TONS	538	KW					2	PAR	

Card 63------------------------------ Cooling Pumps and References ---------------------------------

Cool Ref Num	CHILLED WATER Full Load Value	CHILLED WATER Full Load Units	CONDENSER Full Load Value	CONDENSER Full Load Units	HT REC or AUX Full Load Value	HT REC or AUX Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	29.84	KW	29.84	KW			1		1	
2	55.95	KW	55.95	KW			1		2	

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	22	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE-PUMP HT LOS	43	TONS	FTSAMCLG	CHILL-LD	2			

Card 72-- Switchover Controls ---------

Control Reference	Load Value	Load Units	Outside Air DB	Sched Code
1	425	TONS		

Card 74---------------------------- Condenser / Cooling Tower Parameters ---------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	EQ5100			52.22	KW			2			

Utility Description Reference Table

```
Schedules:
     FSHBARRL  F.S.H. BARRACKS LIGHT/MISC.  SCHEDULE
     FSHBARRP  F.S.H. BARRACKS PEOPLE SCHEDULE
     FSHDINL  F.S.H. DINING LIGHTING/MISC. LOAD SCHED.
     FSHDINP  F.S.H. DINING PEOPLE SCHEDULE
     FSHKITCH  F.S.H. KITCHEN INTERNAL LOAD SCHEDULE
     FSHOFFIC  F.S.H. OFFICE INTERNAL LOAD SCHEDULE
     FTSAMCLG  EEAP BOILER/CHILLER STUDY
     FTSAMHTG  EEAP BOILER/CHILLER STUDY
System:
     MZ  MULTIZONE
     VAV  VARIABLE AIR VOLUME
Equipment:
     Cooling:
          EQ1001S   2-STG CENTRIFUGAL CHILLER <550 TONS
          YCENT134  YORK CENT. R-134A CHILL
          YSCRW22  YORK W.C. SCREW CHILL.
     Heating:
          1300HWHB  EXISTING FORCE DRAFT C.B. HWH BOILER
          1350HWB1  EXISTING NAT. DRAFT RITE HWH BOILER
          1350HWB2  EXISTING NAT. DRAFT AJAX HWH BOILER
          BOILHEFT  HIGH EFFICIENCY MODULAR FIRETUBE BOIL.
          Tower:
               EQ5100  COOLING TOWER FANS
        Misc:
           EQ5001  CHILLED WATER PUMP -  CONSTANT VOLUME
           EQ5020  HEATING WATER CIRCULATION PUMP
           EQ5240  BOILER FORCED DRAFT FAN
```

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																
2	2	BLKPLANT	2	2																

Card 62----------------------------------- Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001S	1	438	TONS	329	KW							
2	EQ1001S	1	544	TONS	517	KW					1	SER	
3	EQ1001S	1	442	TONS	517	KW					2	SER	

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	29.84	KW	22.38	KW					1	
2	18.65	KW	29.84	KW					2	2
3			29.84	KW					2	

Card 65--------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																
2	3	2	2																

Card 67-------------------------------------- Heating Equipment Parameters ---

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	1350HWB1	1	29.84	KW	5317	MBH	7500	MBH	1					
2	1350HWB2	1			4336	MBH	5800	MBH	2					
3	1300HWHB	1	11.19	KW	5912	MBH	8369	MBH	1			1		
4	1300HWHB	1	11.19	KW	5912	MBH	8369	MBH	2			3		

Card 71------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	19.45	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOSS	482.9	MBH	FTSAMHTG	HOT-LD	1			
3	PIPE-PUMP HT LOS	45.56	TONS	FTSAMCLG	CHILL-LD	2			
4	PIPE HT LOSS	1312.5	MBH	FTSAMHTG	HOT-LD	3			

Card 74--------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	EQ5100			52.22	KW			2			

Card 75------------------------------------ Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5020	11.19	KW		EQ5240	7.46	KW					
2	EQ5001	18.65	KW									
3	EQ5240	7.46	KW									

-------------------- Equipment Section Alternative #2 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				WAT. COOLED GAS ENGINE CHLR, EXIST BOILR		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	2																

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING Capacity Value	Capacity Units	COOLING Energy Value	Energy Units	HEAT RECOVERY Capacity Value	Capacity Units	HEAT RECOVERY Energy Value	Energy Units	Seq Order Num	Seq Type	Demand Limit Number
1	YENGDRIV	1	425	TONS	2805	MBH					1	PAR	

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING Capacity Value	COOLING Capacity Units	COOLING Energy Value	COOLING Energy Units	HEAT RECOVERY Capacity Value	HEAT RECOVERY Capacity Units	HEAT RECOVERY Energy Value	HEAT RECOVERY Energy Units	Seq Order Num	Seq Type	Demand Limit Number
2	YENGDRIV	1	840	TONS	5208	MBH					2	PAR	

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	CHILLED WATER Full Load Value	CHILLED WATER Full Load Units	CONDENSER Full Load Value	CONDENSER Full Load Units	HT REC or AUX Full Load Value	HT REC or AUX Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	29.84	KW	29.84	KW			1		1	
2	55.95	KW	55.95	KW			1		2	

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	22	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE-PUMP HT LOS	43	TONS	FTSAMCLG	CHILL-LD	2			

Card 72-- Switchover Controls ---------

Control Reference	Load Value	Load Units	Outside Air DB	Sched Code
1	425	TONS		

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	EQ5100			52.2	KW			2			

-------------------- Equipment Section Alternative #3 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	Demand Limit Schedule	Demand Limit Temperature Drift
3				W.C. CENTRIFUGAL VFD CHILLER, EXIST BLR		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	2																

Card 62----------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YCENVFD	1	425	TONS	264	KW					1	PAR	
2	YCENVFD	1	840	TONS	487	KW					2	PAR	

Card 63---------------------------- Cooling Pumps and References ---------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	29.84	KW	29.84	KW			1		1	
2	55.95	KW	55.95	KW			1		2	

Card 71-------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	22	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE-PUMP HT LOS	43	TONS	FTSAMCLG	CHILL-LD	2			

Card 72-- Switchover Controls ---------

Control Reference	Load Value	Load Units	Outside Air DB	Sched Code
1	425	TONS		

Card 74--------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			14.92	KW			1	50	7.46	KW
2	EQ5100			52.22	KW			2			

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**                                                                        **
**              T R A C E    6 0 0    A N A L Y S I S                     **
**                                                                        **
**              by  HUITT & ZOLLARS                                       **
**                                                                        **
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03018504 BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS OF ENGINEERS - FT. WORTH, TEXAS
HUITT - ZOLLARS INC.
AREA 1300

Weather File Code:		
Location:	SAN ANTONIO, TEXAS	
Latitude:	29.0	(deg)
Longitude:	98.0	(deg)
Time Zone:	6	
Elevation:	792	(ft)
Barometric Pressure:	29.0	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	97	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	30	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0738	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0818	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,761.9	(Btu-min./hr/cuft)
Enthalpy Factor:	4.4255	(Lb-min./hr/cuft)
Design Simulation Period:	June	To November
System Simulation Period:	January	To December
Cooling Load Methodology:	TETD/Time Averaging	
Time/Date Program was Run:	20: 5:15	6/ 8/95
Dataset Name:	FSH1300 .TM	

SYSTEM TOTALS LOAD PROFILE - ALTERNATIVE 1
EXISTING SYSTEM

-- S Y S T E M   L O A D   P R O F I L E --

System Totals

Percent Design Load	---- Cooling Load ---- Cap. (Ton)	Hours (%)	Hours	------ Heating Load ------ Capacity (Btuh)	Hours (%)	Hours
0 - 5	69.8	4	160	-534,786	18	516
5 - 10	139.5	5	206	-1,069,572	20	576
10 - 15	209.3	5	198	-1,604,358	9	270
15 - 20	279.1	8	316	-2,139,144	9	247
20 - 25	348.8	9	362	-2,673,930	10	274
25 - 30	418.6	6	269	-3,208,716	6	173
30 - 35	488.4	9	396	-3,743,502	10	295
35 - 40	558.2	6	263	-4,278,288	14	398
40 - 45	627.9	6	234	-4,813,074	4	109
45 - 50	697.7	6	265	-5,347,860	0	0
50 - 55	767.5	5	226	-5,882,647	0	0
55 - 60	837.2	8	321	-6,417,432	0	0
60 - 65	907.0	7	296	-6,952,219	0	0
65 - 70	976.8	8	336	-7,487,004	0	0
70 - 75	1,046.5	5	202	-8,021,791	0	0
75 - 80	1,116.3	3	126	-8,556,577	0	0
80 - 85	1,186.1	1	23	-9,091,363	0	0
85 - 90	1,255.9	0	0	-9,626,149	0	0
90 - 95	1,325.6	0	0	-10,160,935	0	0
95 - 100	1,395.4	0	0	-10,695,720	0	0
Hours Off	0.0	0	4,561	0	0	5,902

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	89514	103432	122331	127030	103190	50187	0	0	595,685
	PK	0.0	0.0	0.0	0.0	286.9	267.5	299.6	319.9	290.4	193.8	0.0	0.0	319.9
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	11100	10742	11100	11100	10742	5429	0	0	60,215
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	483	569	673	694	561	270	0	0	3,251
	PK	0.0	0.0	0.0	0.0	1.6	1.5	1.6	1.7	1.6	1.2	0.0	0.0	1.7
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	22201	0	0	131,773
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	16651	16114	16651	16651	16114	16651	0	0	98,830
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	216416	259295	314252	325517	256609	91916	0	0	1,464,005
	PK	0.0	0.0	0.0	0.0	524.9	541.9	549.8	556.5	540.7	371.9	0.0	0.0	556.5
2	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	38852	37598	38852	38852	37598	19065	0	0	210,817
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	1007	1274	1584	1663	1224	387	0	0	7,140
	PK	0.0	0.0	0.0	0.0	3.1	3.3	3.8	4.0	3.5	1.9	0.0	0.0	4.0
2	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
2	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	22201	0	0	131,773
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
2	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	13876	13428	13876	13876	13428	13876	0	0	82,358
	PK	0.0	0.0	0.0	0.0	18.6	18.6	18.6	18.6	18.6	18.6	0.0	0.0	18.6
3	EQ1001S	2-STG CENTRIFUGAL CHILLER <550 TONS												
	ELEC	0	0	0	0	6503	20559	38934	48240	16050	0	0	0	130,286
	PK	0.0	0.0	0.0	0.0	165.4	210.0	305.1	347.3	234.0	0.0	0.0	0.0	347.3
3	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	2626	4715	9250	9489	5073	0	0	0	31,153
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	0.0	0.0	0.0	29.8
3	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	88	158	310	318	170	0	0	0	1,044
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	0.0	1.0
1		030185.04 BLDG 1350 HWH BOILER 1												
	GAS	5565	5263	5068	4904	0	0	0	0	0	0	4904	5696	31,400
	PK	13.2	13.9	6.8	6.8	0.0	0.0	0.0	0.0	0.0	0.0	6.8	11.4	13.9
1	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	22201	20052	22201	21485	0	0	0	0	0	0	21485	22201	129,625
	PK	29.8	29.8	29.8	29.8	0.0	0.0	0.0	0.0	0.0	0.0	29.8	29.8	29.8
1	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2		030185.04 BLDG 1350 HWH BOILER 2												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5311	BOILER CONTROLS												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
3		030185.04 AREA 1300 HWH BOILER(S)												
	GAS	36755	35443	18831	11935	0	0	0	0	0	0	17631	35518	156,112
	PK	81.9	79.4	53.4	19.2	0.0	0.0	0.0	0.0	0.0	0.0	52.2	76.6	81.9
3	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	8325	7520	8325	8057	0	0	0	0	0	0	8057	8325	48,609
	PK	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2
3	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
3	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	8325	7520	8325	8057	0	0	0	0	0	0	8057	8325	48,609
	PK	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2
3	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	5550	5013	5550	5371	0	0	0	0	0	0	5371	5550	32,406
	PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5
4		030185.04 AREA 1300 HWH BOILER(S)												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	EQ5311	BOILER CONTROLS												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
WATER COOLED CENTR. CHILLER, EXIST BOILR

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		----- Monthly Consumption -----												
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	16368	15840	16368	16368	15840	16368	0	0	97,152
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.0
2			BASE UTILITY											
	CHILLD	0	0	0	0	31992	30960	31992	31992	30960	31992	0	0	189,888
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.0
1	EQ1001S		2-STG CENTRIFUGAL CHILLER <550 TONS											
	ELEC	0	0	0	0	70092	85728	108560	96704	93491	62989	0	0	517,565
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.2
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	6863	6058	6669	5804	7311	4499	0	0	37,204
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
WATER COOLED CENTR. CHILLER, EXIST BOILR

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,891
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.7
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	0	85,104
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		CONDENSER WATER PUMP-CV(HIGH EFFIC.)											
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,852
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2			YORK CENTRIFUGAL R-134A CHILLER											
	ELEC	0	0	0	0	124154	158702	198246	223687	144780	18405	0	0	867,974
	PK	0.0	0.0	0.0	0.0	437.4	453.1	475.2	479.0	446.8	373.4	0.0	0.0	479.0
2	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	19418	26204	31685	35131	24534	4385	0	0	141,358
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	884	1133	1401	1562	1034	146	0	0	6,160
	PK	0.0	0.0	0.0	0.0	3.0	3.0	3.1	3.1	3.0	2.7	0.0	0.0	3.1
2	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5011		CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)											
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	372	502	607	673	470	84	0	0	2,708
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
WAT. COOLED GAS ENGINE CHLR, EXIST BOILR

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	16368	15840	16368	16368	15840	16368	0	0	97,152
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.0
2			BASE UTILITY											
	CHILLD	0	0	0	0	31992	30960	31992	31992	30960	31992	0	0	189,888
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.0
1	EQ1001S		2-STG CENTRIFUGAL CHILLER <550 TONS											
	ELEC	0	0	0	0	70092	85728	108560	96704	93491	62989	0	0	517,565
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.2
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	6863	6058	6669	5804	7311	4499	0	0	37,204
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
WAT. COOLED GAS ENGINE CHLR, EXIST BOILR

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,891
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.7
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	0	85,104
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		CONDENSER WATER PUMP-CV(HIGH EFFIC.)											
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,852
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2			YORK ENGINE DRIVEN CHILLER											
	GAS	0	0	0	0	12610	16173	20369	23139	14796	1774	0	0	88,860
	PK	0.0	0.0	0.0	0.0	45.0	47.4	50.6	51.3	47.0	36.7	0.0	0.0	51.3
2	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	19418	26204	31685	35131	24534	4385	0	0	141,358
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	996	1278	1584	1772	1166	160	0	0	6,957
	PK	0.0	0.0	0.0	0.0	3.4	3.5	3.6	3.6	3.4	3.1	0.0	0.0	3.6
2	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5011		CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)											
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	372	502	607	673	470	84	0	0	2,708
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
W.C. CENTRIFUGAL VFD CHILLER, EXIST BLR

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	16368	15840	16368	16368	15840	16368	0	0	97,152
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.0
2			BASE UTILITY											
	CHILLD	0	0	0	0	31992	30960	31992	31992	30960	31992	0	0	189,888
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.0
1	EQ1001S		2-STG CENTRIFUGAL CHILLER <550 TONS											
	ELEC	0	0	0	0	70092	85728	108560	96704	93491	62989	0	0	517,565
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.2
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	6863	6058	6669	5804	7311	4499	0	0	37,204
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
W.C. CENTRIFUGAL VFD CHILLER, EXIST BLR

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,891
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.7
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	0	85,104
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010		CONDENSER WATER PUMP-CV(HIGH EFFIC.)											
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,852
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	YCENVFD		YORK TURBO MODULATOR VAR. FREQ. DRIVE											
	ELEC	0	0	0	0	115650	147760	186147	211694	134793	15891	0	0	811,935
	PK	0.0	0.0	0.0	0.0	419.5	441.7	472.9	479.0	437.2	340.0	0.0	0.0	479.0
2	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	19426	26214	31698	35144	24543	4386	0	0	141,412
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	876	1123	1390	1551	1025	143	0	0	6,109
	PK	0.0	0.0	0.0	0.0	3.0	3.0	3.1	3.1	3.0	2.7	0.0	0.0	3.1
2	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5011		CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)											
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	372	502	607	673	470	84	0	0	2,708
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
WAT. COOLED DUAL SCREW CHILR, EXIST BLR

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	16368	15840	16368	16368	15840	16368	0	0	97,152
	PK	0.0	0.0	0.0	0.0	22.0	22.0	22.0	22.0	22.0	22.0	0.0	0.0	22.0
2			BASE UTILITY											
	CHILLD	0	0	0	0	31992	30960	31992	31992	30960	31992	0	0	189,888
	PK	0.0	0.0	0.0	0.0	43.0	43.0	43.0	43.0	43.0	43.0	0.0	0.0	43.0
1	EQ1001S		2-STG CENTRIFUGAL CHILLER <550 TONS											
	ELEC	0	0	0	0	70092	85728	108560	96704	93491	62989	0	0	517,565
	PK	0.0	0.0	0.0	0.0	268.8	287.1	326.8	330.2	307.2	276.6	0.0	0.0	330.2
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	6863	6058	6669	5804	7311	4499	0	0	37,204
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
WAT. COOLED DUAL SCREW CHILR, EXIST BLR

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	397	484	600	528	527	354	0	0	2,891
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.7	1.7	1.6	1.6	0.0	0.0	1.7
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	13726	12115	13338	11608	14622	19694	0	0	85,104
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5010	CONDENSER WATER PUMP-CV(HIGH EFFIC.)												
	ELEC	0	0	0	0	10295	9086	10004	8706	10966	14771	0	0	63,828
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
1	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	460	406	447	389	490	660	0	0	2,852
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	YSCRW22	YORK W.C. SCREW CHILLER												
	ELEC	0	0	0	0	131905	167567	210224	238248	150736	18266	0	0	916,945
	PK	0.0	0.0	0.0	0.0	483.0	500.4	524.8	529.0	493.4	412.3	0.0	0.0	529.0
2	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	19426	26214	31698	35144	24543	4386	0	0	141,412
	PK	0.0	0.0	0.0	0.0	52.2	52.2	52.2	52.2	52.2	52.2	0.0	0.0	52.2
2	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	891	1142	1412	1576	1039	145	0	0	6,204
	PK	0.0	0.0	0.0	0.0	3.0	3.1	3.1	3.1	3.0	2.8	0.0	0.0	3.1
2	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5011	CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)												
	ELEC	0	0	0	0	20813	28087	33962	37654	26297	4700	0	0	151,513
	PK	0.0	0.0	0.0	0.0	56.0	56.0	56.0	56.0	56.0	56.0	0.0	0.0	56.0
2	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	372	502	607	673	470	84	0	0	2,708
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
EXISTING CHILLERS, HIGH % MODULAR BOILRS

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	248076	224754	249404	239859	248740	241188	247411	249404	239859	248740	241187	241432	2,920,053
	PK	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0	689.0
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	HOTLD	13358	12065	13358	12927	0	0	0	0	0	0	12927	13358	77,992
	PK	18.0	18.0	18.0	18.0	0.0	0.0	0.0	0.0	0.0	0.0	18.0	18.0	18.0
1		HIGH EFFICIENCY MODULAR FIRETUBE BOIL.												
	GAS	14880	13440	14725	14142	0	0	0	0	0	0	14257	14880	86,323
	PK	20.0	20.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	20.0	20.0
1	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	4166	3763	4166	4032	0	0	0	0	0	0	4032	4166	24,326
	PK	5.6	5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.6
1	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
EXISTING CHILLERS, HIGH % MODULAR BOILRS

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Description	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2		HIGH EFFICIENCY MODULAR FIRETUBE BOIL.													
	GAS		10665	11051	4016	9	0	0	0	0	0	0	3581	10438	39,761
	PK		20.0	20.0	20.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	20.0	20.0	20.0
2	EQ5020	HEATING WATER CIRCULATION PUMP													
	ELEC		4166	3763	1870	84	0	0	0	0	0	0	1691	4166	15,742
	PK		5.6	5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.6
2	EQ5311	BOILER CONTROLS													
	ELEC		93	84	42	2	0	0	0	0	0	0	38	93	351
	PK		0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
3		HIGH EFFICIENCY MODULAR FIRETUBE BOIL.													
	GAS		6138	6228	383	0	0	0	0	0	0	0	234	6204	19,188
	PK		20.0	20.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	20.0	20.0
3	EQ5020	HEATING WATER CIRCULATION PUMP													
	ELEC		2195	2150	510	0	0	0	0	0	0	0	342	2307	7,504
	PK		5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.6
3	EQ5311	BOILER CONTROLS													
	ELEC		49	48	11	0	0	0	0	0	0	0	8	52	167
	PK		0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
4		HIGH EFFICIENCY MODULAR FIRETUBE BOIL.													
	GAS		1004	722	0	0	0	0	0	0	0	0	0	313	2,039
	PK		9.9	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	9.9
4	EQ5020	HEATING WATER CIRCULATION PUMP													
	ELEC		1086	1053	0	0	0	0	0	0	0	0	0	818	2,957
	PK		5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6
4	EQ5311	BOILER CONTROLS													
	ELEC		24	23	0	0	0	0	0	0	0	0	0	18	66
	PK		0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

01 Card - Job Information

Project: 03018504 EEAP BOILER-CHILLER STUDY
Location: FT. SAM HOUSTON - SAN ANTONIO, TX.
Client: CORPS OF ENGINEERS - FORT WORTH, TEXAS
Program User: HUITT - ZOLLARS INC.
Comments: AREA 2200

Card 08 -------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
SANANTON								

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	AREA 2200

Card 20 -- General Room Parameters --

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
5	5	BLDG 2263	264	265	3	3	2.54	11			
15	15	DINING 2265	77	77	3	2.5	2.54	11			
20	20	BARR 2265	299	299	3	2.5	2.54	11			
25	25	ADMIN 2264	221	222	3	2.5	2.54	11			
30	30	BARR 2264	221	222	3	2.5	2.54	11			
35	35	ADMIN 2266	221	222	3	2.5	2.54	11			
40	40	BARR 2266	221	222	3	2.5	2.54	11			

Card 21 -------------------------------- Thermostat Parameters --

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
5	78	50	78		70	70		ROOM	LIGHT30	YES
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	YES

Card 21-------------------------------- Thermostat Parameters ---------------------------------------

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
25	78	50	78		70	70		ROOM	LIGHT30	YES
30	78	50	78		70	70		ROOM	LIGHT30	YES
35	78	50	78		70	70		ROOM	LIGHT30	YES
40	78	50	78		70	70		ROOM	LIGHT30	YES

Card 22------------------------ Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
5	1	NO	164	164	.09	37		80	
20	1	NO	165	166	.09	37		80	
30	1	NO	165	166	.09	37		80	
40	1	NO	165	166	.09	37		80	

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
5	1	924	11	.49	74	0		.74	
5	2	414	11	.49	74	90		.74	
5	3	924	11	.49	74	180		.74	
5	4	414	11	.49	74	270		.74	
15	1	309	11	.41	94	0		.74	
20	1	810	11	.41	94	0		.74	
20	2	243	11	.41	94	90		.74	
20	3	810	11	.41	94	180		.74	
20	4	243	11	.41	94	270		.74	
25	1	357	11	.41	94	0		.74	
25	2	81	11	.41	94	90		.74	
25	3	357	11	.41	94	180		.74	
25	4	81	11	.41	94	270		.74	
30	1	714	11	.41	94	0		.74	
30	2	162	11	.41	94	90		.74	
30	3	714	11	.41	94	180		.74	
30	4	162	11	.41	94	270		.74	
35	1	357	11	.41	94	0		.74	
35	2	81	11	.41	94	90		.74	
35	3	357	11	.41	94	180		.74	
35	4	81	11	.41	94	270		.74	
40	1	714	11	.41	94	0		.74	
40	2	162	11	.41	94	90		.74	
40	3	714	11	.41	94	180		.74	
40	4	162	11	.41	94	270		.74	

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
5	1	3	6	97	1.1	.67					
5	2			16	.63	1					
5	3			32	.57	1					
5	4			16	.63	1					
15	1	3	6	35	1.1	.67					
20	1	3	6	82	1.1	.67					
20	2	3	6	27	1.1	.67					
20	3	3	6	96	1.1	.67	3				
20	4	3	6	27	1.1	.67					
25	1	3	6	41	1.1	.67					
25	2	3	6	9	1.1	.67					
25	3	3	6	48	1.1	.67	3				
25	4	3	6	9	1.1	.67					
30	1	3	6	82	1.1	.67					
30	2	3	6	18	1.1	.67					
30	3	3	6	96	1.1	.67	3				
30	4	3	6	18	1.1	.67					
35	1	3	6	41	1.1	.67					
35	2	3	6	9	1.1	.67					
35	3	3	6	48	1.1	.67	3				
35	4	3	6	9	1.1	.67					
40	1	3	6	82	1.1	.67					
40	2	3	6	18	1.1	.67					
40	3	3	6	96	1.1	.67	3				
40	4	3	6	18	1.1	.67					

Card 26-- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
5	FSHOFFIC	FSHOFFIC								
15	FSHDINP	FSHDINL								
20	FSHBARRP	FSHBARRL								
25	FSHOFFIC	FSHOFFIC								
30	FSHBARRP	FSHBARRL								
35	FSHOFFIC	FSHOFFIC								
40	FSHBARRP	FSHBARRL								

Card 27------------------------------------ People and Lights --

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
5	250	PEOPLE	250	200	2.5	WATT-SF	ASHRAE2				
15	400	PEOPLE	275	275	1.3	WATT-SF	ASHRAE2				

Card 27------------------------------------ People and Lights --

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
20	215	PEOPLE	250	200	.8	WATT-SF	ASHRAE2				
25	40	PEOPLE	250	200	2.0	WATT-SF	ASHRAE2				
30	350	PEOPLE	250	200	.8	WATT-SF	ASHRAE2				
35	40	PEOPLE	250	200	2.0	WATT-SF	ASHRAE2				
40	350	PEOPLE	250	200	.8	WATT-SF	ASHRAE2				

Card 28-- Miscellaneous Equipment --

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
5	1	COMPUTER	1	WATT-SF	FSHOFFIC						
15	1	DIN. EQ.	1	WATT-SF	FSHDINL						
20	1	T.V. ETC.	1	WATT-SF	FSHBARRL						
25	1	COMPUTER	1	WATT-SF	FSHOFFIC						
30	1	T.V. ETC.	1	WATT-SF	FSHBARRL						
35	1	COMPUTER	1	WATT-SF	FSHOFFIC						
40	1	T.V. ETC.	1	WATT-SF	FSHBARRL						

Card 29-- Room Airflows ---

Room	-------------Ventilation-------------				-------------Infiltration------------				--Reheat Minimum--	
	-----Cooling-----		-----Heating-----		-----Cooling-----		-----Heating-----			
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
5	20	CFM-P	20	CFM-P						
15	20	CFM-P	20	CFM-P						
20	20	CFM-P	20	CFM-P						
25	20	CFM-P	20	CFM-P						
30	20	CFM-P	20	CFM-P						
35	20	CFM-P	20	CFM-P						
40	20	CFM-P	20	CFM-P						

Card 33-------------------------------- External Shading ---------------------------------------

	---------OVERHANG---------			-------------------VERTICAL FINS-------------------					
Shading Type	Glass Height	Height Above Glass	Projection Out	Glass Width	Projection Left	Left Projection Out	Projection Right	Right Projection Out	Adjacent Building Flag
3	6	1	5						

-------------------- System Section Alternative #1 --------------------

Card 39- System Alternative

Number	Description
1	EXISTING SYSTEM

Card 40---------------------- System Type -----------------------------

System Set Number	System Type	Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
		------------OPTIONAL VENTILATION SYSTEM------------					
1	SZ						

Card 41-- Zone Assignment ---

System Set Number	Ref #1 Begin	Ref #1 End	Ref #2 Begin	Ref #2 End	Ref #3 Begin	Ref #3 End	Ref #4 Begin	Ref #4 End	Ref #5 Begin	Ref #5 End	Ref #6 Begin	Ref #6 End
1	5	40										

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Rm Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	2	2									

Card 45------------------------------------ Equipment Schedules ---

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules -----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001L	1	657	TONS	595	KW							

Card 63----------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	74.6	KW	37.3	KW					1	

Card 65--- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																

Card 67--------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	2200EXST	1	11.19	KW	2240	MBH	3000	MBH	1			1		
2	2200EXST	1	11.19	KW	2240	MBH	3000	MBH	2			2		
3	2200EXST	1	11.19	KW	2240	MBH	3000	MBH	3			3		

Card 71--------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	39.1	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOSS	612.2	MBH	FTSAMHTG	HOT-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters ---------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			29.84	KW			2			

Card 75------------------------------------- Miscellaneous Accessory ---

	#1				#2				#3			
Misc Ref	Equip Code	Energy Value	Energy Units	Sched Code	Equip Code	Energy Value	Energy Units	Sched Code	Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5013	.56	KW									
2	EQ5013	.56	KW									
3	EQ5013	.56	KW									

-------------------- Equipment Section Alternative #2 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				GAS ENGINE DRIVEN CHILLER, EXISTING BLR		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62----------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YENGDRIV	1	555	TONS	3663	MBH							

Card 63----------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	74.6	KW	37.3	KW					1	

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	39.1	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			29.84	KW			2			

-------------------- Equipment Section Alternative #3 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules -----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				W. C. DUAL SCREW CHILLER, EXIST BOILER		

Card 60--- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62------------------------------------ Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YSCRW22	1	555	TONS	355	KW							

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	74.6	KW	37.3	KW					1	

Card 71-------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	39.1	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			29.84	KW			2			

-------------------- Equipment Section Alternative #4 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ---------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
4				W.C. CENTRIFUGAL CHILLER, EXISTING BOILR		

Card 60--- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin End	-Group 2- Begin End	-Group 3- Begin End	-Group 4- Begin End	-Group 5- Begin End	-Group 6- Begin End	-Group 7- Begin End	-Group 8- Begin End	-Group 9- Begin End
1		BLKPLANT	1 1								

Card 62------------------------------------ Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YCENT134	1	555	TONS	322	KW							

Card 63---------------------------- Cooling Pumps and References -----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	74.6	KW	37.3	KW					1	

Card 71--------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	39.1	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units

Utility Description Reference Table

```
Schedules:
     FSHBARRL  F.S.H. BARRACKS LIGHT/MISC.  SCHEDULE
     FSHBARRP  F.S.H. BARRACKS PEOPLE SCHEDULE
     FSHDINL  F.S.H. DINING LIGHTING/MISC. LOAD SCHED.
     FSHDINP  F.S.H. DINING PEOPLE SCHEDULE
     FSHOFFIC  F.S.H. OFFICE INTERNAL LOAD SCHEDULE
     FTSAMCLG  EEAP BOILER/CHILLER STUDY
     FTSAMHTG  EEAP BOILER/CHILLER STUDY
System:
     SZ  SINGLE ZONE
Equipment:
     Cooling:
          EQ1001L   2-STG CENTRIFUGAL CHILLER >550 TONS
          YCENT134  YORK CENT. R-134A CHILL
          YENGDRIV  YORK ENGINE DRIVEN CHILLER
          YSCRW22  YORK W.C. SCREW CHILL.
     Heating:
          2200EXST  EXISTING NAT. DRAFT AJAX HWH BOILER
          Tower:
               EQ5100  COOLING TOWER FANS
        Misc:
           EQ5013  WATER CIRCULATING PUMP - CONSTANT VOLUME
```

Card 39- System Alternative

Number	Description
1	EXISTING SYSTEM

Card 40---------------------- System Type -----------------------------

------------OPTIONAL VENTILATION SYSTEM-----------

System Set Number	System Type	Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
1	SZ						

Card 41--------------------------------------- Zone Assignment ---

System Set Number	Ref #1 Begin	Ref #1 End	Ref #2 Begin	Ref #2 End	Ref #3 Begin	Ref #3 End	Ref #4 Begin	Ref #4 End	Ref #5 Begin	Ref #5 End	Ref #6 Begin	Ref #6 End
1	5	40										

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	2	2									

Card 45------------------------------------ Equipment Schedules ---

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	-Group 1- End	-Group 2- Begin	-Group 2- End	-Group 3- Begin	-Group 3- End	-Group 4- Begin	-Group 4- End	-Group 5- Begin	-Group 5- End	-Group 6- Begin	-Group 6- End	-Group 7- Begin	-Group 7- End	-Group 8- Begin	-Group 8- End	-Group 9- Begin	-Group 9- End
1	1	BLKPLANT	1	1																

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING Capacity Value	COOLING Capacity Units	COOLING Energy Value	COOLING Energy Units	HEAT RECOVERY Capacity Value	HEAT RECOVERY Capacity Units	HEAT RECOVERY Energy Value	HEAT RECOVERY Energy Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1001L	1	657	TONS	595	KW							

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	CHILLED WATER Full Load Value	CHILLED WATER Full Load Units	CONDENSER Full Load Value	CONDENSER Full Load Units	HT REC or AUX Full Load Value	HT REC or AUX Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	74.6	KW	37.3	KW					1	

Card 65-- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																

Card 67------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	2200EXST	1	11.19	KW	2240	MBH	3000	MBH	1			1		
2	2200EXST	1	11.19	KW	2240	MBH	3000	MBH	2			2		
3	2200EXST	1	11.19	KW	2240	MBH	3000	MBH	3			3		

Card 71-------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	39.1	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOSS	612.2	MBH	FTSAMHTG	HOT-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			29.84	KW			2			

Card 75------------------------------------- Miscellaneous Accessory ---

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5013	.56	KW									
2	EQ5013	.56	KW									
3	EQ5013	.56	KW									

-------------------- Equipment Section Alternative #2 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				W.C. CENTRIFUGAL CHILLER-VFD, EXIST BLR		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																

Card 62------------------------------------ Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	YCENVFD	1	555	TONS	322	KW							

Card 63----------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	74.6	KW	37.3	KW					1	

Card 71-------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	39.1	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5100			29.84	KW			2			

-------------------- Equipment Section Alternative #3 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				EXIST CHILLER, NATURAL DRAFT HIGH BLR		

Card 65-------------------------------------- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																

Card 67-------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	BOILHEFT	1	5.6	KW	1830	MBH	2000	MBH	1			1		
2	BOILHEFT	1			915	MBH	1000	MBH	2					

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE HT LOS	612.2	MBH	FTSAMHTG	HOT-LD	1			

Card 75-------------------------------------- Miscellaneous Accessory ---

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5020	3.73	KW									

```
*   ***********************************************************************
*   ***********************************************************************
**                                                                      **
**               T R A C E   6 0 0   A N A L Y S I S                    **
**                                                                      **
**               by  HUITT & ZOLLARS                                    **
**                                                                      **
**************************************************************************
**************************************************************************
```

03018504 EEAP BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS OF ENGINEERS - FORT WORTH, TEXAS
HUITT - ZOLLARS INC.
AREA 2200

Weather File Code:		
Location:	SAN ANTONIO, TEXAS	
Latitude:	29.0	(deg)
Longitude:	98.0	(deg)
Time Zone:	6	
Elevation:	792	(ft)
Barometric Pressure:	29.0	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	97	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	30	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0738	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0818	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,761.9	(Btu-min./hr/cuft)
Enthalpy Factor:	4.4255	(Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 19: 5: 7 6/ 8/95
Dataset Name: FSH2200 .TM

EM TOTALS LOAD PROFILE - ALTERNATIVE 1

-- S Y S T E M   L O A D   P R O F I L E --

System Totals

Percent Design Load	---- Cooling Load ---- Cap. (Ton)	Hours (%)	Hours	------ Heating Load ------ Capacity (Btuh)	Hours (%)	Hours
0 - 5	32.2	7	279	-213,687	50	1,134
5 - 10	64.4	5	211	-427,375	14	307
10 - 15	96.7	6	235	-641,062	4	82
15 - 20	128.9	9	367	-854,749	7	168
20 - 25	161.1	8	349	-1,068,437	16	363
25 - 30	193.3	7	281	-1,282,124	3	78
30 - 35	225.6	8	324	-1,495,811	2	46
35 - 40	257.8	7	286	-1,709,499	2	49
40 - 45	290.0	5	223	-1,923,186	1	21
45 - 50	322.2	9	358	-2,136,873	1	15
50 - 55	354.5	8	318	-2,350,561	0	0
55 - 60	386.7	9	366	-2,564,248	0	0
60 - 65	418.9	5	204	-2,777,936	0	0
65 - 70	451.1	6	253	-2,991,623	0	0
75	483.3	1	43	-3,205,311	0	0
75 - 80	515.6	2	66	-3,418,998	0	0
80 - 85	547.8	0	0	-3,632,685	0	0
85 - 90	580.0	0	0	-3,846,373	0	0
90 - 95	612.2	0	0	-4,060,060	0	0
95 - 100	644.5	0	0	-4,273,747	0	0
Hours Off	0.0	0	4,597	0	0	6,497

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,666
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.1
2		BASE UTILITY												
	HOTLD	4555	4114	4555	4408	0	0	0	0	0	0	4408	4555	26,594
	PK	6.1	6.1	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.1	6.1
1	EQ1001L	2-STG CENTRIFUGAL CHILLER >550 TONS												
	ELEC	0	0	0	0	151580	173401	204346	211763	166768	86289	0	0	$\boxed{994,146}$
	PK	0.0	0.0	0.0	0.0	481.0	522.3	568.8	596.6	535.0	368.3	0.0	0.0	596.6
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	11898	0	0	$\boxed{121,471}$
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	699	804	952	980	757	378	0	0	4,569
	PK	0.0	0.0	0.0	0.0	2.3	2.4	2.6	2.6	2.5	1.9	0.0	0.0	2.6
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5010		CONDENSER WATER PUMP-CV(HIGH EFFIC.)											
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1			EXISTING NAT. DRAFT AJAX HWH BOILER											
	GAS	10454	10246	6486	5991	0	0	0	0	0	0	6240	9940	49,358
	PK	30.0	30.0	10.9	9.3	0.0	0.0	0.0	0.0	0.0	0.0	10.4	30.0	30.0
1	EQ5013		WATER CIRCULATING PUMP - CONSTANT VOLUME											
	ELEC	8325	7520	8325	8057	0	0	0	0	0	0	8057	8325	48,609
	PK	11.2	11.2	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2	11.2
1	EQ5311		BOILER CONTROLS											
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1	EQ5013		WATER CIRCULATING PUMP - CONSTANT VOLUME											
	ELEC	417	376	417	403	0	0	0	0	0	0	403	417	2,433
	PK	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
2			EXISTING NAT. DRAFT AJAX HWH BOILER											
	GAS	17	91	0	0	0	0	0	0	0	0	0	19	127
	PK	2.4	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	5.1
2	EQ5013		WATER CIRCULATING PUMP - CONSTANT VOLUME											
	ELEC	134	269	0	0	0	0	0	0	0	0	0	67	470
	PK	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2
2	EQ5311		BOILER CONTROLS											
	ELEC	2	3	0	0	0	0	0	0	0	0	0	1	5
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	7	13	0	0	0	0	0	0	0	0	0	3	24
	PK	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6
3		EXISTING NAT. DRAFT AJAX HWH BOILER												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5311	BOILER CONTROLS												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	EQ5013	WATER CIRCULATING PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
GAS ENGINE DRIVEN CHILLER, EXISTING BLR

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,666
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.1
1			YORK ENGINE DRIVEN CHILLER											
	GAS	0	0	0	0	9807	11472	13818	14498	11113	5068	0	0	65,775
	PK	0.0	0.0	0.0	0.0	33.9	34.6	36.2	36.6	35.3	24.9	0.0	0.0	36.6
1	EQ5100		COOLING TOWER FANS											
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	11600	0	0	121,172
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5100		COOLING TOWER FANS											
	WATER	0	0	0	0	736	851	1013	1046	803	390	0	0	4,840
	PK	0.0	0.0	0.0	0.0	2.4	2.4	2.4	2.4	2.4	2.0	0.0	0.0	2.4

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
GAS ENGINE DRIVEN CHILLER, EXISTING BLR

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011			CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)										
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
W. C. DUAL SCREW CHILLER, EXIST BOILER

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,666
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.1
1	YSCRW22	YORK W.C. SCREW CHILL.												
	ELEC	0	0	0	0	94351	109968	131558	137516	106569	51609	0	0	631,571
	PK	0.0	0.0	0.0	0.0	338.4	343.0	352.2	355.0	347.1	264.5	0.0	0.0	355.0
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	12459	0	0	122,031
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	647	746	886	912	702	346	0	0	4,239
	PK	0.0	0.0	0.0	0.0	2.1	2.1	2.1	2.1	2.1	1.8	0.0	0.0	2.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
W. C. DUAL SCREW CHILLER, EXIST BOILER

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	329,433
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011			CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)										
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	164,717
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
W.C. CENTRIFUGAL CHILLER, EXISTING BOILR

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,666
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.1
1		YORK CENT. R-134A CHILL												
	ELEC	0	0	0	0	92599	106789	126901	132023	103005	50227	0	0	611,543
	PK	0.0	0.0	0.0	0.0	306.9	311.1	319.4	322.0	314.8	240.0	0.0	0.0	322.0
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	12467	0	0	122,039
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	645	743	882	907	699	345	0	0	4,221
	PK	0.0	0.0	0.0	0.0	2.1	2.1	2.1	2.1	2.1	1.8	0.0	0.0	2.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 4
W.C. CENTRIFUGAL CHILLER, EXISTING BOILR

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	$\boxed{329,433}$
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011			CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)										
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	$\boxed{164,717}$
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
W.C. CENTRIFUGAL CHILLER-VFD, EXIST BLR

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	29090	28152	29090	29090	28152	29090	0	0	172,666
	PK	0.0	0.0	0.0	0.0	39.1	39.1	39.1	39.1	39.1	39.1	0.0	0.0	39.1
1	YCENVFD	YORK TURBO MODULATOR VAR. FREQ. DRIVE												
	ELEC	0	0	0	0	82189	96782	117375	123391	93614	41497	0	0	554,847
	PK	0.0	0.0	0.0	0.0	297.8	304.5	317.9	322.0	310.5	216.8	0.0	0.0	322.0
1	EQ5100	COOLING TOWER FANS												
	ELEC	0	0	0	0	22201	21485	22201	22201	21485	12289	0	0	121,861
	PK	0.0	0.0	0.0	0.0	29.8	29.8	29.8	29.8	29.8	29.8	0.0	0.0	29.8
1	EQ5100	COOLING TOWER FANS												
	WATER	0	0	0	0	636	734	873	899	690	337	0	0	4,169
	PK	0.0	0.0	0.0	0.0	2.0	2.1	2.1	2.1	2.1	1.8	0.0	0.0	2.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
W.C. CENTRIFUGAL CHILLER-VFD, EXIST BLR

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	55502	53712	55502	55502	53712	55502	0	0	$\boxed{329,433}$
	PK	0.0	0.0	0.0	0.0	74.6	74.6	74.6	74.6	74.6	74.6	0.0	0.0	74.6
1	EQ5011			CONDENSER WATER PUMP-CV(MEDIUM EFFIC.)										
	ELEC	0	0	0	0	27751	26856	27751	27751	26856	27751	0	0	$\boxed{164,717}$
	PK	0.0	0.0	0.0	0.0	37.3	37.3	37.3	37.3	37.3	37.3	0.0	0.0	37.3
1	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
EXIST CHILLER, NATURAL DRAFT HIGH % BLR

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	93324	84377	98571	89467	95947	94714	90700	98571	89467	95947	89467	90700	1,111,251
	PK	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3	452.3
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	HOTLD	4555	4114	4555	4408	0	0	0	0	0	0	4408	4555	26,594
	PK	6.1	6.1	6.1	6.1	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.1	6.1
1			HIGH EFFICIENCY MODULAR FIRETUBE BOIL.											
	GAS	8361	8169	5293	4889	0	0	0	0	0	0	5092	8030	$\boxed{39,833}$
	PK	20.0	20.0	8.9	7.6	0.0	0.0	0.0	0.0	0.0	0.0	8.5	20.0	20.0
1	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	4166	3763	4166	4032	0	0	0	0	0	0	4032	4166	$\boxed{24,326}$
	PK	5.6	5.6	5.6	5.6	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.6	5.6
1	EQ5311		BOILER CONTROLS											
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
EXIST CHILLER, NATURAL DRAFT HIGH % BLR

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	2775	2507	2775	2686	0	0	0	0	0	0	2686	2775	$\boxed{16,203}$
	PK	3.7	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	3.7
2		HIGH EFFICIENCY MODULAR FIRETUBE BOIL.												
	GAS	189	269	0	0	0	0	0	0	0	0	0	97	$\boxed{555}$
	PK	6.7	8.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	8.6
2	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	1	1	0	0	0	0	0	0	0	0	0	1	$\boxed{3}$
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	EQ5311	BOILER CONTROLS												
	ELEC	7	7	0	0	0	0	0	0	0	0	0	4	19
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

01 Card - Job Information

Project: 030185.04 EEAP BOILER-CHILLER STUDY
Location: FT. SAM HOUSTON - SAN ANTONIO, TX.
Client: CORPS OF ENGINEERS - FORT WORTH, TEXAS
Program User: HUITT - ZOLLARS INC.
Comments: QUADANGLE AREA

Card 08-------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
SANANTON								

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	QUADRANGLE LOAD DESCRIPTION

Card 20--- General Room Parameters --

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
5	5	BLDG T56	181	45	3	3	2.54	15			
10	10	BLDG 44	309	309	3	4.5	2.54	16			
15	15	BLDG 4015	121	121	3	3	1.2	12			
20	20	BLDG 16	276	276	3	6	2.54	17			

Card 21--------------------------------- Thermostat Parameters ---------------------------------------

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
5	78	50	78		70	70		ROOM	LIGHT30	NO
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO

Card 22------------------------ Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
5	1	YES			.10	47		67	.9
10	1	NO	221	221	.09	23		90	.9
15	1	NO	245	39	.22	47		90	.74
20	1	NO	1582	34	.10	47		60	.74

Card 24-------------------------- Wall Parameters -------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
5	1	153	14	.26	58	90		.74	
5	2	30	14	.26	58	0		.74	
5	3	17	14	.13	88	0		.74	
5	4	181	14	.13	88	270		.74	
5	5	45	14	.13	88	180		.74	
5	6	28	14	.13	88	90		.74	
10	1	200	16	.19	58	0		.9	
10	2	232	16	.19	58	180		.9	
10	3	230	16	.19	58	270		.9	
10	4	364	16	.18	88	0		.74	
10	5	482	16	.18	88	90		.74	
10	6	342	16	.18	88	180		.74	
10	7	260	16	.18	88	270		.74	
15	1	39	12	.22	52	0		.74	
15	2	245	12	.22	52	90		.74	
15	3	39	12	.22	52	180		.74	
15	4	245	12	.22	52	270		.74	
20	1	600	15.5	.2	64	0		.74	
20	2	1016	15.5	.2	64	90		.74	
20	3	600	15.5	.2	64	180		.74	
20	4	1016	15.5	.2	64	270		.74	

Card 25--- Wall/Glass Parameters ---

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
5	1	3.5	6.5	16	1.1	.67					
5	2	3.5	6.5	1	1.1	.67					
5	4	2.5	3	12	1.1	1					
5	5	3.5	6.5	4	1.1	.67					
10	1	5	8	17	1.1	.67					
10	2	5	8	13	1.1	.67					
10	3	5	8	17	1.1	.67					
10	4	3.5	8	29	1.1	.67					
10	5	3.5	8	51	1.1	.67					
10	6	3.5	8	57	1.1	.67					

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
10	7	3.5	8	21	1.1	.67					
15	1	3	6	11	1.1	.67					
15	2	3	6	89	1.1	.67					
15	3	3	6	10	1.1	.67					
15	4	3	6	96	1.1	.67					
20	1			48	.56	1					
20	2	3	6	56	1.1	.67					
20	3	3	6	84	1.1	.67					
20	4	3	6	56	1.1	.67					

Card 26-- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
5	FSHOFFIC	FSHOFFIC								
10	FSHOFFIC	FSHOFFIC								
15	FSHOFFIC	FSHOFFIC								
20	FSHOFFIC	FSHOFFIC								

Card 27------------------------------------ People and Lights ---

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
5	64	PEOPLE	250	200	2	WATT-SF	ASHRAE2				
10	500	PEOPLE	250	200	2.5	WATT-SF	SUSFLUOR				
15	110	PEOPLE	250	200	2	WATT-SF	SUSFLUOR				
20	150	SF-PERS	250	200	2.25	WATT-SF	ASHRAE2				

Card 28-- Miscellaneous Equipment ---

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
5	1	COMPUTER	1	WATT-SF	FSHOFFIC						
10	1	COMPUTER	2	WATT-SF	FSHOFFIC						
15	1	COMPUTER	2.5	WATT-SF	FSHOFFIC						
20	1	COMPUTER	1.25	WATT-SF	FSHOFFIC						

Card 29-- Room Airflows ---

	--------------Ventilation--------------				--------------Infiltration------------					
Room	-----Cooling-----		-----Heating-----		-----Cooling-----		-----Heating-----		--Reheat Minimum--	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
5	20	CFM-P	20	CFM-P						

Card 29-- Room Airflows --

	--------------Ventilation--------------				------------Infiltration------------					
Room	-----Cooling-----		-----Heating-----		-----Cooling-----		-----Heating-----		--Reheat Minimum--	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
10	20	CFM-P	20	CFM-P						
15	15	CFM-P	15	CFM-P						
20	20	CFM-P	20	CFM-P						

-------------------- System Section Alternative #1 --------------------

Card 39- System Alternative

Number	Description
1	EXISTING SYSTEM

Card 40---------------------- System Type -----------------------------

		------------OPTIONAL VENTILATION SYSTEM------------					
System Set Number	System Type	Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
1	MZ						
2	SZ						
3	MZ						
4	SZ						

Card 41-- Zone Assignment --

System	Ref #1		Ref #2		Ref #3		Ref #4		Ref #5		Ref #6	
Set Number	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End	Begin	End
1	5	5										
2	10	10										
3	15	15										
4	20	20										

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	2.0										
2	1.5										
3	1.5										

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
4	1.5										

Card 45------------------------------------ Equipment Schedules ---

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG				
2	FTSAMCLG					FTSAMHTG				
3	FTSAMCLG					FTSAMHTG				
4	FTSAMCLG					FTSAMHTG				

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit ---- Schedule	Temperature Drift
1				BASE CASE		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																
2	2	BLKPLANT	2	2																
3	5	BLKPLANT	3	3																
4	6	BLKPLANT	4	4																

Card 62----------------------------------- Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	QUADACRE	1	30	TONS	49	KW							
2	QUADACRE	1	65	TONS	114	KW					1	PAR	
3	QUADACRE	1	95	TONS	167	KW					2	PAR	
4	QUADACRE	1	95	TONS	167	KW					3	PAR	
5	QUADACRE	1	50	TONS	88.4	KW							
6	QUADACRE	1	120	TONS	194	KW					1	PAR	

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING Capacity Value	COOLING Capacity Units	COOLING Energy Value	COOLING Energy Units	HEAT RECOVERY Capacity Value	HEAT RECOVERY Capacity Units	HEAT RECOVERY Energy Value	HEAT RECOVERY Energy Units	Seq Order Num	Seq Type	Demand Limit Number
7	QUADACRE	1	110	TONS	190	KW					2	PAR	

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	CHILLED WATER Full Load Value	CHILLED WATER Full Load Units	CONDENSER Full Load Value	CONDENSER Full Load Units	HT REC or AUX Full Load Value	HT REC or AUX Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	3.73	KW								3
2	14.92	KW								
3	3.73	KW								
4	3.73	KW								
5	3.73	KW								
6	5.6	KW								2

Card 65--------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1	4	4														
2	3	2	2																
3	15	3	3																

Card 67-------------------------------------- Heating Equipment Parameters ---

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	QUAEXIST	1			3587	MBH	5000	MBH	1					
2	QUAEXIST	1			1614	MBH	2250	MBH	2					
3	QUAEXIST	1			264	MBH	385	MBH	1					
4	QUAEXIST	1			264	MBH	385	MBH	2					
5	QUAEXIST	1			264	MBH	385	MBH	3					
6	QUAEXIST	1			264	MBH	385	MBH	4					
7	QUAEXIST	1			264	MBH	385	MBH	5					
8	QUAEXIST	1			264	MBH	385	MBH	6					
9	QUAEXIST	1			264	MBH	385	MBH	7					
10	QUAEXIST	1			236	MBH	335	MBH	8					
11	QUAEXIST	1			236	MBH	335	MBH	9					
12	QUAEXIST	1			236	MBH	335	MBH	10					
13	QUAEXIST	1			236	MBH	335	MBH	11					
14	QUAEXIST	1			236	MBH	335	MBH	12					
15	EQ2001	1	2.24	KW	741	MBH	1000	MBH				1		

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE PUMP HT LOS	1.6	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOSS	68.1	MBH	FTSAMHTG	HOT-LD	1			
3	PIPE PUMP HT LOS	10.2	TONS	FTSAMCLG	CHILL-LD	2			
4	PIPE HT LOSS	54.5	MBH	FTSAMHTG	HOT-LD	2			
5	PIPE PUMP HT LOS	2.5	TONS	FTSAMCLG	CHILL-LD	5			
6	PIPE HT LOSS	17.71	MBH	FTSAMHTG	HOT-LD	14			
7	PIPE PUMP HT LOS	5.9	TONS	FTSAMCLG	CHILL-LD	6			

Card 75------------------------------------- Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5240	3.73	KW									
2	EQ5001	5.6	KW		EQ5105	9.33	KW					
3	EQ5001	3.73	KW									

-------------------- Equipment Section Alternative #2 --------------------

Card 59--------------------------- Equipment Description / TOD Schedules ---------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				A.C. SCREW CHILLERS		

Card 60-- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	4																

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1510	1	275	TONS	351	KW					1	PAR	
2	EQ1510	1	275	TONS	351	KW					2	PAR	

Card 63----------------------------- Cooling Pumps and References ---------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	22.38	KW							1	
2	22.38	KW							1	

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	20.2	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5200			0	KW						

-------------------- Equipment Section Alternative #3 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				EXIST STEAM BLR WITH NEW HWH GENERATOR		

Card 65--------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin End	-Group 2- Begin End	-Group 3- Begin End	-Group 4- Begin End	-Group 5- Begin End	-Group 6- Begin End	-Group 7- Begin End	-Group 8- Begin End	-Group 9- Begin End
1	1	1 4								

Card 67------------------------------------- Heating Equipment Parameters ---

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	QUAEXIST	1			3587	MBH	5000	MBH				1		

Card 71 --- Base Utility Parameters ---

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE HT LOSS	140.3	MBH	FTSAMHTG	HOT-LD	1			

Card 75 --- Miscellaneous Accessory ---

	#1				#2				#3			
Misc Ref	Equip Code	Energy Value	Energy Units	Sched Code	Equip Code	Energy Value	Energy Units	Sched Code	Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5020	2.24	KW									

Utility Description Reference Table

Schedules:
- FSHOFFIC F.S.H. OFFICE INTERNAL LOAD SCHEDULE
- FTSAMCLG EEAP BOILER/CHILLER STUDY
- FTSAMHTG EEAP BOILER/CHILLER STUDY

System:
- MZ MULTIZONE
- SZ SINGLE ZONE

Equipment:
- Cooling:
  - EQ1510 AIR COOLED SERIES R (RTAA)
  - QUADACRE QUAD AIR COOLED RECIP CHILLER(S)
- Heating:
  - EQ2001 GAS FIRED HOT WATER BOILER
  - QUAEXIST QUAD AREA EXIST STEAM BOILER
  - Tower:
    - EQ5200 CONDENSER FANS
- Misc:
  - EQ5001 CHILLED WATER PUMP - CONSTANT VOLUME
  - EQ5020 HEATING WATER CIRCULATION PUMP
  - EQ5105 EVAPORATIVE CONDENSER FANS
  - EQ5240 BOILER FORCED DRAFT FAN

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**                                                                       **
**              T R A C E   6 0 0   A N A L Y S I S                      **
**                                                                       **
**              by  HUITT & ZOLLARS                                      **
**                                                                       **
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030185.04 EEAP BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS OF ENGINEERS - FORT WORTH, TEXAS
HUITT - ZOLLARS INC.
QUADANGLE AREA

Weather File Code:	
Location:	SAN ANTONIO, TEXAS
Latitude:	29.0 (deg)
Longitude:	98.0 (deg)
Time Zone:	6
Elevation:	792 (ft)
Barometric Pressure:	29.0 (in. Hg)
Summer Clearness Number:	0.90
Winter Clearness Number:	0.90
Summer Design Dry Bulb:	97 (F)
Summer Design Wet Bulb:	76 (F)
Winter Design Dry Bulb:	30 (F)
Summer Ground Relectance:	0.20
Winter Ground Relectance:	0.20
Air Density:	0.0738 (Lbm/cuft)
Air Specific Heat:	0.2444 (Btu/lbm/F)
Density-Specific Heat Prod:	1.0818 (Btu-min./hr/cuft/F)
Latent Heat Factor:	4,761.9 (Btu-min./hr/cuft)
Enthalpy Factor:	4.4255 (Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 8:28:39 6/12/95
Dataset Name: FSH4ANGL .TM

SYSTEM TOTALS LOAD PROFILE - ALTERNATIVE 1

-- S Y S T E M   L O A D   P R O F I L E --

System Totals

Percent Design Load	---- Cooling Load ---- Cap. (Ton)	Hours (%)	Hours	------ Heating Load ------ Capacity (Btuh)	Hours (%)	Hours
0 - 5	27.8	14	569	-140,290	57	907
5 - 10	55.5	9	371	-280,581	8	124
10 - 15	83.3	11	430	-420,871	6	100
15 - 20	111.1	8	307	-561,161	5	80
20 - 25	138.8	9	351	-701,452	3	48
25 - 30	166.6	9	346	-841,742	4	60
30 - 35	194.3	6	246	-982,032	5	81
35 - 40	222.1	2	73	-1,122,323	2	25
40 - 45	249.9	3	129	-1,262,613	0	6
45 - 50	277.6	4	141	-1,402,904	3	54
50 - 55	305.4	3	108	-1,543,194	6	99
55 - 60	333.2	3	131	$\boxed{-1,683,484}$	1	16
60 - 65	360.9	2	86	-1,823,775	0	0
65 - 70	388.7	3	131	-1,964,065	0	0
70 - 75	416.5	3	128	-2,104,355	0	0
75 - 80	444.2	4	168	-2,244,646	0	0
80 - 85	472.0	4	172	-2,384,936	0	0
85 - 90	499.8	1	43	-2,525,227	0	0
90 - 95	$\boxed{527.5}$	1	43	-2,665,517	0	0
95 - 100	555.3	0	0	-2,805,807	0	0
Hours Off	0.0	0	4,787	0	0	7,160

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	77510	70128	84891	73819	81200	81200	73819	84891	73819	81200	73819	73819	930,115
	PK	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	1190	1152	1190	1190	1152	1190	0	0	7,066
	PK	0.0	0.0	0.0	0.0	1.6	1.6	1.6	1.6	1.6	1.6	0.0	0.0	1.6
2			BASE UTILITY											
	HOTLD	507	458	507	490	0	0	0	0	0	0	490	507	2,958
	PK	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
3			BASE UTILITY											
	CHILLD	0	0	0	0	7589	7344	7589	7589	7344	7589	0	0	45,043
	PK	0.0	0.0	0.0	0.0	10.2	10.2	10.2	10.2	10.2	10.2	0.0	0.0	10.2
4			BASE UTILITY											
	HOTLD	405	366	405	392	0	0	0	0	0	0	392	405	2,367
	PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
5			BASE UTILITY											
	CHILLD	0	0	0	0	1860	1800	1860	1860	1800	1860	0	0	11,040
	PK	0.0	0.0	0.0	0.0	2.5	2.5	2.5	2.5	2.5	2.5	0.0	0.0	2.5
6			BASE UTILITY											
	HOTLD	132	119	132	128	0	0	0	0	0	0	128	132	769
	PK	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2
7			BASE UTILITY											
	CHILLD	0	0	0	0	4390	4248	4390	4390	4248	4390	0	0	26,054
	PK	0.0	0.0	0.0	0.0	5.9	5.9	5.9	5.9	5.9	5.9	0.0	0.0	5.9
1			QUAD AIR COOLED RECIP CHILLER(S)											
	ELEC	0	0	0	0	11383	13937	16680	16889	12081	5786	0	0	76,755
	PK	0.0	0.0	0.0	0.0	36.9	40.4	43.9	44.1	37.5	27.4	0.0	0.0	44.1
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
2			QUAD AIR COOLED RECIP CHILLER(S)											
	ELEC	0	0	0	0	46937	51983	56803	57761	50614	32096	0	0	296,194
	PK	0.0	0.0	0.0	0.0	98.2	106.1	113.6	115.1	103.4	93.6	0.0	0.0	115.1
2	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	11100	10742	11100	11100	10742	11100	0	0	65,887
	PK	0.0	0.0	0.0	0.0	14.9	14.9	14.9	14.9	14.9	14.9	0.0	0.0	14.9
2	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
3			QUAD AIR COOLED RECIP CHILLER(S)											
	ELEC	0	0	0	0	32997	43350	54743	56746	34944	20449	0	0	243,230
	PK	0.0	0.0	0.0	0.0	143.1	155.5	166.4	168.7	151.4	137.2	0.0	0.0	168.7

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Monthly Consumption Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
3	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	1071	1417	1768	1790	1119	656	0	0	7,822
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
3	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	287	380	474	480	300	176	0	0	2,097
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
4			QUAD AIR COOLED RECIP CHILLER(S)											
	ELEC	0	0	0	0	16188	19446	21238	24712	17761	4890	0	0	104,234
	PK	0.0	0.0	0.0	0.0	143.1	155.5	166.4	168.7	151.4	121.0	0.0	0.0	168.7
4	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	492	574	597	686	522	164	0	0	3,036
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
4	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	132	154	160	184	140	44	0	0	814
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
5			QUAD AIR COOLED RECIP CHILLER(S)											
	ELEC	0	0	0	0	27434	32405	38181	38370	28141	15749	0	0	180,278
	PK	0.0	0.0	0.0	0.0	83.1	86.8	90.0	89.3	83.4	76.9	0.0	0.0	90.0
5	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
5	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
6			QUAD AIR COOLED RECIP CHILLER(S)											
	ELEC	0	0	0	0	56711	73757	86637	85892	62230	27804	0	0	393,031
	PK	0.0	0.0	0.0	0.0	159.0	185.9	188.5	189.2	166.5	157.2	0.0	0.0	189.2
6	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	4166	4032	4166	4166	4032	4166	0	0	24,730
	PK	0.0	0.0	0.0	0.0	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0	5.6
6	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
6	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	4166	4032	4166	4166	4032	4166	0	0	24,730
	PK	0.0	0.0	0.0	0.0	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0	5.6
6	EQ5105			EVAPORATIVE CONDENSER FANS										
	ELEC	0	0	0	0	6942	6718	6942	6942	6718	6942	0	0	41,201
	PK	0.0	0.0	0.0	0.0	9.3	9.3	9.3	9.3	9.3	9.3	0.0	0.0	9.3
7				QUAD AIR COOLED RECIP CHILLER(S)										
	ELEC	0	0	0	0	19262	20759	27811	31913	18382	4632	0	0	122,759
	PK	0.0	0.0	0.0	0.0	155.6	170.6	184.6	185.3	160.4	119.9	0.0	0.0	185.3
7	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	154	154	200	230	140	44	0	0	922
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1				QUAD AREA EXIST STEAM BOILER										
	GAS	2063	1913	207	0	0	0	0	0	0	0	350	1977	6,509
	PK	11.5	12.0	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	11.4	12.0
1	EQ5311			BOILER CONTROLS										
	ELEC	57	53	11	0	0	0	0	0	0	0	17	55	192
	PK	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2				QUAD AREA EXIST STEAM BOILER										
	GAS	277	239	619	684	0	0	0	0	0	0	556	292	2,665
	PK	1.0	1.0	1.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0
2	EQ5311			BOILER CONTROLS										
	ELEC	36	31	81	90	0	0	0	0	0	0	73	38	351
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
3				QUAD AREA EXIST STEAM BOILER										
	GAS	374	347	0	0	0	0	0	0	0	0	0	308	1,029
	PK	3.8	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8
3	EQ5311			BOILER CONTROLS										
	ELEC	14	13	0	0	0	0	0	0	0	0	0	11	38
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
4			QUAD AREA EXIST STEAM BOILER											
	GAS	262	221	0	0	0	0	0	0	0	0	0	180	663
	PK	3.8	3.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	3.8
4	EQ5311		BOILER CONTROLS											
	ELEC	11	9	0	0	0	0	0	0	0	0	0	8	28
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
5			QUAD AREA EXIST STEAM BOILER											
	GAS	5	20	0	0	0	0	0	0	0	0	0	8	33
	PK	0.3	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.9
5	EQ5311		BOILER CONTROLS											
	ELEC	3	4	0	0	0	0	0	0	0	0	0	2	9
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
6			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
9	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10			QUAD AREA EXIST STEAM BOILER											
	GAS	1	0	0	0	0	0	0	0	0	0	0	0	1
	PK	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
10	EQ5311		BOILER CONTROLS											
	ELEC	1	0	0	0	0	0	0	0	0	0	0	0	1
	PK	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
11			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14			QUAD AREA EXIST STEAM BOILER											
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14	EQ5311		BOILER CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
BASE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
15	EQ2001	GAS FIRED HOT WATER BOILER												
	GAS	392	351	23	0	0	0	0	0	0	0	59	379	1,204
	PK	2.9	3.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	2.9	3.0
15	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	562	484	72	0	0	0	0	0	0	0	161	542	1,821
	PK	2.2	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	2.2
15	EQ5240	BOILER FORCED DRAFT FAN												
	ELEC	1361	806	358	0	0	0	0	0	0	0	828	921	4,275
	PK	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	3.7

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
A.C. SCREW CHILLERS

-------------------- EQUIPMENT ENERGY CONSUMPTION --------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	77510	70128	84891	73819	81200	81200	73819	84891	73819	81200	73819	73819	930,115
	PK	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	15029	14544	15029	15029	14544	15029	0	0	89,203
	PK	0.0	0.0	0.0	0.0	20.2	20.2	20.2	20.2	20.2	20.2	0.0	0.0	20.2
1	EQ1510	AIR COOLED SERIES R (RTAA)												
	ELEC	0	0	0	0	88155	109763	136458	139682	93439	39506	0	0	607,003
	PK	0.0	0.0	0.0	0.0	287.6	328.3	351.0	351.0	306.5	271.9	0.0	0.0	351.0
1	EQ5200	CONDENSER FANS												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	16651	16114	16651	16651	16114	16651	0	0	98,830
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
A.C. SCREW CHILLERS

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5302		CONTROLS											
	ELEC	0	0	0	0	74	72	74	74	72	74	0	0	442
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
2	EQ1510		AIR COOLED SERIES R (RTAA)											
	ELEC	0	0	0	0	37029	47686	52699	56867	42171	17101	0	0	253,553
	PK	0.0	0.0	0.0	0.0	287.6	328.3	351.0	351.0	306.5	216.4	0.0	0.0	351.0
2	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	3939	4924	4924	5147	4476	2350	0	0	25,759
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
2	EQ5302		CONTROLS											
	ELEC	0	0	0	0	18	22	22	23	20	11	0	0	115
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
EXIST STEAM BLR WITH NEW HWH GENERATOR

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	77510	70128	84891	73819	81200	81200	73819	84891	73819	81200	73819	73819	930,115
	PK	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	HOTLD	1044	943	1044	1010	0	0	0	0	0	0	1010	1044	6,095
	PK	1.4	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	1.4	1.4	1.4
1		QUAD AREA EXIST STEAM BOILER												
	GAS	4107	3752	1598	1408	0	0	0	0	0	0	1692	3883	$\boxed{16,440}$
	PK	23.0	24.3	8.2	2.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	23.1	24.3
1	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	1667	1505	1667	1613	0	0	0	0	0	0	1613	1667	$\boxed{9,731}$
	PK	2.2	2.2	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.2	2.2

01 Card - Job Information

Project: 030185.04 EEAP BOILER-CHILLER STUDY
Location: FT. SAM HOUSTON - SAN ANTONIO, TX.
Client: CORPS. OF ENGINEERS - FORT WORTH, TX.
Program User: HUITT-ZOLLARS INC.
Comments: AREA 100

Card 08--------------------------- Climatic Information ------------------------------

Weather Code	Summer Clearness Number	Winter Clearness Number	Summer Design Dry Bulb	Summer Design Wet Bulb	Winter Design Dry Bulb	Building Orientation	Summer Ground Reflect	Winter Ground Reflect
SANANTON								

-------------------- Load Section Alternative #1 --------------------

Card 19- Load Alternative -

Number	Description
1	EXISTING BUILDINGS

Card 20-- General Room Parameters --

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
5	5	BLDG 122	113	113	3	3	2.54	11			
10	10	BLDG 124	113	113	3	3	2.54	11			
15	15	BLDG 128	119	119	3	8	2.54	18			
20	20	BLDG 133	100	96	3	8	2.54	18			
25	25	BLDG 134	102	102	3	3	2.54	12			
30	30	BLDG 143	122	122	3	3	2.54	12			
35	35	BLDG 144	122	122	3	3	2.54	12			
40	40	BLDG 145	122	122	3	3	2.54	12			
45	45	BLDG 146	122	122	3	3	2.54	12			
50	50	BLDG 147	122	122	3	3	2.54	12			
55	55	BLDG 149	122	122	3	3	2.54	12			
60	60	BLDG 197	122	122	3	3	2.54	12			
65	65	BLDG 198	68	68	3	5	2.54	14			
70	70	BLDG 199	80	80	3	2	2.54	12			
75	75	BLDG 125	50	26	3	5	2.54	15			
80	80	BLDG 127	50	26	3	5	2.54	15			
85	85	BLDG 135	50	26	3	5	2.54	15			

Card 20--- General Room Parameters --

Room Number	Zone Reference Number	Room Descrip	Floor Length	Floor Width	Const Type	Plenum Height	Acoustic Ceiling Resistance	Floor to Floor Height	Duplicate Floors Multiplier	Duplicate Rooms per Zone	Perimeter Depth
90	90	BLDG 250-1	142	34	3	2	2.54	10.5			
95	95	BLDG 250-2	195	195	3	2	2.54	10.5			
100	100	BLDG. 142	65	65	3	2	2.54	10	1	1	

Card 21--------------------------------- Thermostat Parameters ---------------------------------------

Room Number	Cooling Room Design DB	Room Design RH	Cooling T'stat Driftpoint	Cooling T'stat Schedule	Heating Room Design DB	Heating T'stat Driftpoint	Heating T'stat Schedule	T'stat Location Flag	Mass / No. Hrs Average	Carpet On Floor
5	78	50	78		70	70		ROOM	LIGHT30	NO
10	78	50	78		70	70		ROOM	LIGHT30	NO
15	78	50	78		70	70		ROOM	LIGHT30	NO
20	78	50	78		70	70		ROOM	LIGHT30	NO
25	78	50	78		70	70		ROOM	LIGHT30	NO
30	78	50	78		70	70		ROOM	LIGHT30	NO
35	78	50	78		70	70		ROOM	LIGHT30	NO
40	78	50	78		70	70		ROOM	LIGHT30	NO
45	78	50	78		70	70		ROOM	LIGHT30	NO
50	78	50	78		70	70		ROOM	LIGHT30	NO
55	78	50	78		70	70		ROOM	LIGHT30	NO
60	78	50	78		70	70		ROOM	LIGHT30	NO
65	78	50	78		70	70		ROOM	LIGHT30	NO
70	78	50	78		70	70		ROOM	LIGHT30	NO
75	78	50	78		70	70		ROOM	LIGHT30	NO
80	78	50	78		70	70		ROOM	LIGHT30	NO
85	78	50	78		70	70		ROOM	LIGHT30	NO
90	78	50	78		70	70		ROOM	LIGHT30	NO
95	78	50	78		70	70		ROOM	LIGHT30	NO
100	78	50	78		70	70		ROOM	LIGHT30	YES

Card 22------------------------- Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
5	1	NO	180	30	.08	37	0	60	.9
10	1	NO	180	30	.08	37	0	60	.9
15	1	YES			.08	37	0	60	.9
20	1	YES			.08	37	0	60	.9
25	1	NO	73	74	.05	40	0	45	.9
30	1	NO	146	28	.05	40	0	80	.9
35	1	NO	146	28	.05	40	0	80	.9
40	1	NO	146	28	.05	40	0	80	.9
45	1	NO	146	28	.05	40	0	80	.9
50	1	NO	146	28	.05	40	0	80	.9

Card 22------------------------- Roof Parameters ------------------------------

Room Number	Roof Number	Roof Equal to Floor?	Roof Length	Roof Width	Roof U-Value	Const Type	Roof Direction	Roof Tilt	Roof Alpha
55	1	NO	146	28	.05	40	0	80	.9
60	1	NO	146	28	.05	40	0	80	.9
65	1	NO	39	39	.08	37	0	60	.9
70	1	NO	56	57	.05	37	0	60	.9
75	1	YES			.08	37	0	60	.9
80	1	YES			.08	37	0	60	.9
85	1	YES			.08	37	0	60	.9
90	1	YES			.06	23	0	90	.9
95	1	NO	113	113	.06	23	0	90	.9
100	1	NO	47	33	0.05	40	0	80	.9

Card 24--------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
5	1	360	11	.17	58	330	0	.74	1
5	2	60	11	.17	58	60	0	.74	1
5	3	360	11	.17	58	150	0	.74	1
5	4	60	11	.17	58	240	0	.74	1
10	1	360	11	.17	58	315	0	.74	1
10	2	60	11	.17	58	45	0	.74	1
10	3	360	11	.17	58	135	0	.74	1
10	4	60	11	.17	58	225	0	.74	1
15	1	100	18	.10	58	315	0	.9	1
15	2	96	18	.10	58	45	0	.9	1
15	3	100	18	.10	52	135	0	.9	1
15	4	96	18	.10	58	225	0	.9	1
20	1	100	18	.10	58	330	0	.9	1
20	2	96	18	.10	58	60	0	.9	1
20	3	100	18	.10	52	150	0	.9	1
20	4	96	18	.10	58	240	0	.9	1
25	1	280	12	.11	88	315	0	.9	1
25	2	60	12	.11	88	45	0	.9	1
25	3	280	12	.11	88	135	0	.9	1
25	4	60	12	.11	88	225	0	.9	1
30	1	292	12	.10	58	0	0	.9	1
30	2	56	12	.10	58	90	0	.9	1
30	3	292	12	.10	58	180	0	.9	1
30	4	56	12	.10	58	270	0	.9	1
35	1	292	12	.10	58	0	0	.9	1
35	2	56	12	.10	58	90	0	.9	1
35	3	292	12	.10	58	180	0	.9	1
35	4	56	12	.10	58	270	0	.9	1
40	1	292	12	.10	58	0	0	.9	1
40	2	56	12	.10	58	90	0	.9	1

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
40	3	292	12	.10	58	180	0	.9	1
40	4	56	12	.10	58	270	0	.9	1
45	1	292	12	.10	58	0	0	.9	1
45	2	56	12	.10	58	90	0	.9	1
45	3	292	12	.10	58	180	0	.9	1
45	4	56	12	.10	58	270	0	.9	1
50	1	292	12	.10	58	90	0	.9	1
50	2	56	12	.10	58	180	0	.9	1
50	3	292	12	.10	58	270	0	.9	1
50	4	56	12	.10	58	0	0	.9	1
55	1	292	12	.10	58	90	0	.9	1
55	2	56	12	.10	58	180	0	.9	1
55	3	292	12	.10	58	270	0	.9	1
55	4	56	12	.10	58	0	0	.9	1
60	1	292	12	.10	58	320	0	.9	1
60	2	56	12	.10	58	50	0	.9	1
60	3	292	12	.10	58	140	0	.9	1
60	4	56	12	.10	58	230	0	.9	1
65	1	27.5	14	.12	74	0	0	.74	1
65	2	59	14	.12	74	90	0	.74	1
65	3	27.5	14	.12	74	180	0	.74	1
65	4	59	14	.12	74	270	0	.74	1
70	1	126	12	.12	74	315	0	.74	1
70	2	31	12	.12	74	45	0	.74	1
70	3	126	12	.12	74	135	0	.74	1
70	4	31	12	.12	74	225	0	.74	1
75	1	50	15	.17	58	315	0	.74	1
75	2	26	15	.17	58	45	0	.74	1
75	3	50	15	.17	58	135	0	.74	1
75	4	26	15	.17	58	225	0	.74	1
80	1	50	15	.17	58	315	0	.74	1
80	2	26	15	.17	58	45	0	.74	1
80	3	50	15	.17	58	135	0	.74	1
80	4	26	15	.17	58	225	0	.74	1
85	1	50	15	.17	58	315	0	.74	1
85	2	26	15	.17	58	45	0	.74	1
85	3	50	15	.17	58	135	0	.74	1
85	4	26	15	.17	58	225	0	.74	1
90	1	142	10.5	.12	74	0	0	.74	1
90	2	58	10.5	.12	74	90	0	.74	1
90	3	52	10.5	.12	74	180	0	.74	1
90	4	58	10.5	.12	74	270	0	.74	1
95	1	20	10.5	.12	74	0	0	.74	1
95	2	798	10.5	.12	74	90	0	.74	1
95	3	60	10.5	.12	74	180	0	.74	1
95	4	798	10.5	.12	74	270	0	.74	1
100	1	118	10	.16	64	0	0	.74	1

Card 24-------------------------- Wall Parameters --------------------------------

Room Number	Wall Number	Wall Length	Wall Height	Wall U-Value	Wall Constuc Type	Wall Direction	Wall Tilt	Wall Alpha	Ground Reflectance Multiplier
100	2	83	10	.16	64	0	0	.74	1
100	3	118	10	.16	64	0	0	.74	1
100	4	83	10	.16	64	0	0	.74	1

Card 25--- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
5	1	5	3	34	1.1	.67					
5	2	5	3	6	1.1	.67					
5	3	5	3	34	1.1	.67	3				
5	4	5	3	6	1.1	.67					
10	1	5	3	34	1.1	.67					
10	2	5	3	6	1.1	.67					
10	3	5	3	34	1.1	.67	3				
10	4	5	3	6	1.1	.67					
15	1	7	3	8	1.1	.67					
15	2	7	3	7	1.1	.67					
15	3	7	3	9	1.1	.67					
15	4	7	3	7	1.1	.67					
20	1	7	3	8	1.1	.67					
20	2	7	3	7	1.1	.67					
20	3	7	3	9	1.1	.67					
20	4	7	3	7	1.1	.67					
25	1	6	3	26	.8	.67					
25	2	6	3	5	.8	.67					
25	3			29	.53	1					
25	4	6	3	5	.8	.67					
30	1	7	3.5	21	1.1	.67	3				
30	2	7	3.5	6	1.1	.67					
30	3			35	1.1	.67	3				
30	4	7	3.5	6	1.1	.67					
35	1	7	3.5	21	1.1	.67	3				
35	2	7	3.5	6	1.1	.67					
35	3			35	1.1	.67	3				
35	4	7	3.5	6	1.1	.67					
40	1	7	3.5	21	1.1	.67	3				
40	2	7	3.5	6	1.1	.67					
40	3			35	1.1	.67	3				
40	4	7	3.5	6	1.1	.67					
45	1	7	3.5	21	1.1	.67	3				
45	2	7	3.5	6	1.1	.67					
45	3			35	1.1	.67	3				
45	4	7	3.5	6	1.1	.67					
50	1	7	3.5	21	1.1	.67	3				

Card 25-- Wall/Glass Parameters --

Room Number	Wall Number	Glass Length	Glass Width	Pct Glass or No. of Windows	Glass U-Value	Shading Coefficient	External Shading Type	Internal Shading Type	Percent Solar to Ret. Air	Visible Transmittance	Inside Visible Reflectance
50	2	7	3.5	6	1.1	.67					
50	3			35	1.1	.67	3				
50	4	7	3.5	6	1.1	.67					
55	1	7	3.5	21	1.1	.67	3				
55	2	7	3.5	6	1.1	.67					
55	3			35	1.1	.67	3				
55	4	7	3.5	6	1.1	.67					
60	1	7	3.5	21	1.1	.67	3				
60	2	7	3.5	6	1.1	.67					
60	3			35	1.1	.67	3				
60	4	7	3.5	6	1.1	.67					
65	1	5	3	6	1.1	.67					
65	2	5	3	11	1.1	.67	3				
65	3	5	3	6	1.1	.67					
65	4	5	3	11	1.1	.67	3				
70	1	5	3	10	1.1	.67	3				
70	2	5	3	2	1.1	.67					
70	3	5	3	10	1.1	.67					
70	4	5	3	2	1.1	.67					
75	1	8	3	4	.73	.67					
75	2	8	3	2	.73	.67					
75	3	8	3	4	.73	.67					
75	4	8	3	2	.73	.67					
80	1	8	3	4	.73	.67					
80	2	8	3	2	.73	.67					
80	3	8	3	4	.73	.67					
80	4	8	3	2	.73	.67					
85	1	8	3	4	.73	.67					
85	2	8	3	2	.73	.67					
85	3	8	3	4	.73	.67					
85	4	8	3	2	.73	.67					
90	1	4	2	3	1.1	1					
90	3	7	5	3	1.1	1					
90	4	7	5	3	1.1	1					
95	2	4	2	114	1.1	.67					
95	3	4	2	6	1.1	.67					
95	4	4	2	114	1.1	.67					
100	1	5	3.5	5	1.1	0.67					
100	2	5	3.5	6	1.1	0.67					
100	3	5	3.5	7	1.1	0.67					
100	4	5	3.5	6	1.1	0.67					

Card 26-- Schedules --

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
5	FSHOFFIC	FSHOFFIC								

Card 26-- Schedules ---

Room Number	People	Lights	Ventilation	Infiltration	Reheat Minimum	Cooling Fans	Heating Fan	Auxiliary Fan	Room Exhaust	Daylighting Controls
10	FSHOFFIC	FSHOFFIC								
15	FSHOFFIC	FSHOFFIC								
20	FSHOFFIC	FSHOFFIC								
25	FSHOFFIC	FSHOFFIC								
30	FSHOFFIC	FSHOFFIC								
35	FSHOFFIC	FSHOFFIC								
40	FSHOFFIC	FSHOFFIC								
45	FSHOFFIC	FSHOFFIC								
50	FSHBARRP	FSHBARRL								
55	FSHBARRP	FSHBARRL								
60	FSHOFFIC	FSHOFFIC								
65	FSHOFFIC	FSHOFFIC								
70	FSHOFFIC	FSHOFFIC								
75	FSHOFFIC	FSHOFFIC								
80	FSHOFFIC	FSHOFFIC								
85	FSHOFFIC	FSHOFFIC								
90	FSHOFFIC	FSHOFFIC								
95	FSHBARRP	FSHBARRP								
100	FSHOFFIC	FSHOFFIC								

Card 27------------------------------------ People and Lights ---

Room Number	People Value	People Units	People Sensible	People Latent	Lighting Value	Lighting Units	Lighting Fixture Type	Ballast Factor	Percent Lights to Ret. Air	--- Daylighting ---- Reference Point 1	Reference Point 2
5	60	PEOPLE	250	200	2	WATT-SF	ASHRAE2	1			
10	60	PEOPLE	250	200	2	WATT-SF	ASHRAE2	1			
15	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
20	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
25	175	SF-PERS	250	200	2.25	WATT-SF	ASHRAE2	1			
30	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1			
35	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1			
40	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1			
45	175	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1			
50	45	PEOPLE	250	200	1.5	WATT-SF	ASHRAE2	1			
55	45	PEOPLE	250	200	1.5	WATT-SF	ASHRAE2	1			
60	250	SF-PERS	250	200	3	WATT-SF	ASHRAE2	1			
65	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
70	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
75	100	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
80	100	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
85	100	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			
90	160	SF-PERS	250	200	2	WATT-SF	INCAND	1			
95	160	SF-PERS	250	200	1.5	WATT-SF	INCAND	1			
100	175	SF-PERS	250	200	2	WATT-SF	ASHRAE2	1			

Card 28-- Miscellaneous Equipment --

Room Number	Misc Equipment Number	Equipment Descrip	Energy Consump Value	Energy Consump Units	Schedule Code	Energy Meter Code	Percent of Load Sensible	Percent Misc. Load to Room	Percent Misc. Sens to Ret. Air	Radiant Fraction	Optional Air Path
5	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
10	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
15	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
20	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
25	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
30	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
35	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
40	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
45	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
50	1	T.V.-ETC.	1	WATT-SF	FSHBARRL	NONE	100	100			
55	1	T.V.-ETC.	1	WATT-SF	FSHBARRL	NONE	100	100			
60	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
65	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
70	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
75	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
80	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
85	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
90	1	COMPUTER	1	WATT-SF	FSHOFFIC	NONE	100	100			
95	1	COMPUTER	1	WATT-SF	FSHBARRL	NONE	100	100			
100	1	COMPUTERS	1	WATT-SF	FSHOFFIC	NONE	100	100			

Card 29-- Room Airflows --

	-------------Ventilation-------------				-------------Infiltration------------					
Room	-----Cooling-----		-----Heating-----		-----Cooling-----		-----Heating-----		--Reheat Minimum--	
Number	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
5	20	CFM-P	20	CFM-P						
10	20	CFM-P	20	CFM-P						
15	20	CFM-P	20	CFM-P						
20	20	CFM-P	20	CFM-P						
25	20	CFM-P	20	CFM-P						
30	20	CFM-P	20	CFM-P						
35	20	CFM-P	20	CFM-P						
40	20	CFM-P	20	CFM-P						
45	20	CFM-P	20	CFM-P						
50	15	CFM-P	15	CFM-P						
55	15	CFM-P	15	CFM-P						
60	20	CFM-P	20	CFM-P						
65	20	CFM-P	20	CFM-P						
70	20	CFM-P	20	CFM-P						
75	20	CFM-P	20	CFM-P						
80	20	CFM-P	20	CFM-P						
85	20	CFM-P	20	CFM-P						
90	20	CFM-P	20	CFM-P						
95	20	CFM-P	20	CFM-P						
100	20	CFM-P	20	CFM-P						

Card 32------------------------------ Exposed Floor Parameters--------------------------------------

	Exposed	-----Slab------		------------------------Exposed Floor-----------------------						
Room Number	Floor Number	Perimeter Length	Loss Coefficient	Floor Area	Floor U-Value	Const Type	Temp Flag	Cooling Temp	Heating Temp	Adjacent Room No
5	1			5400	.19	119	HRLYOADB			
10	1			5400	.19	119	HRLYOADB			
15	1			14224	.19	119	HRLYOADB			
20	1			9600	.19	119	HRLYOADB			
50	1			5400	.19	119	HRLYOADB			
55	1			5400	.19	119	HRLYOADB			
70	1			3906	.25	119	HRLYOADB			

Card 33-------------------------------- External Shading ---------------------------------------

	---------OVERHANG---------			--------------------VERTICAL FINS-------------------					
Shading Type	Glass Height	Height Above Glass	Projection Out	Glass Width	Projection Left	Left Projection Out	Projection Right	Right Projection Out	Adjacent Building Flag
3	5	2	8						

-------------------- System Section Alternative #1 --------------------

Card 39- System Alternative

Number	Description
1	AREA 100 EXISTING SYSTEMS

Card 40---------------------- System Type -----------------------------

		------------OPTIONAL VENTILATION SYSTEM-----------					
System Set Number	System Type	Ventil Deck Location	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
1	MZ						
2	MZ						
3	MZ						
4	MZ						
5	MZ						
6	MZ						
7	MZ						
8	MZ						
9	MZ						
10	MZ						
11	MZ						
12	MZ						
13	MZ						
14	MZ						
15	MZ						

Card 40---------------------- System Type -----------------------------

System Set Number	System Type	Ventil Deck Location (OPTIONAL VENTILATION SYSTEM)	Cooling SADBVh	Heating SADBVh	Cooling Schedule	Heating Schedule	Fan Static Pressure
16	MZ						
17	MZ						
18	MZ						
19	MZ						
20	SZ						

Card 41-------------------------------------- Zone Assignment ---

System Set Number	Ref #1 Begin	Ref #1 End	Ref #2 Begin	Ref #2 End	Ref #3 Begin	Ref #3 End	Ref #4 Begin	Ref #4 End	Ref #5 Begin	Ref #5 End	Ref #6 Begin	Ref #6 End
1	5	5										
2	10	10										
3	15	15										
4	20	20										
5	25	25										
6	30	30										
7	35	35										
8	40	40										
9	45	45										
10	50	50										
11	55	55										
12	60	60										
13	65	65										
14	70	70										
15	75	75										
16	80	80										
17	85	85										
18	90	90										
19	95	95										
20	100	100										

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
1	1										
2	1										
3	2.25										
4	2.25										
5	1.5										
6	1.4										
7	1.4										

Card 42----------------------- Fan SP and Duct Parameters------------------------------

System Set Number	Cool Fan SP	Heat Fan SP	Return Fan SP	Mn Exh Fan SP	Aux Fan SP	Rm Exh Fan SP	Cool Fan Mtr Loc	Return Fan Mtr Loc	Supply Duct Ht Gn	Supply Duct Loc	Return Air Path
8	.5										
9	1.4										
10	1.4										
11	1.4										
12	1.4										
13	1.5										
14	1.5										
15	1										
16	1										
17	1										
18	2.5										
19	2.5										
20	1.0	1.0									

Card 45------------------------------------ Equipment Schedules ---

System Set Number	Main Cooling Coil	Economizer	Direct Evap Coil	Indirect Evap Coil	Auxiliary Cooling Coil	Main Heating Coil	Main Preheat Coil	Reheat Coil	Mech. Humidity	Auxiliary Heating Coil
1	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
2	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
3	OFF					OFF	OFF	OFF		
4	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
5	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
6	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
7	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
8	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
9	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
10	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
11	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
12	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
13	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
14	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
15	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
16	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
17	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
18	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
19	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		
20	FTSAMCLG					FTSAMHTG	FTSAMHTG	FTSAMHTG		

-------------------- Equipment Section Alternative #1 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
1				BASE CASE		

Card 60-- Cooling Load Assignment--

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	1																
2	2	BLKPLANT	2	2	15	15														
3	3	BLKPLANT	3	3																
4	4	BLKPLANT	4	4																
5	5	BLKPLANT	5	5	17	17														
6	6	BLKPLANT	6	6																
7	7	BLKPLANT	7	7																
8	9	BLKPLANT	8	8																
9	10	BLKPLANT	9	9																
10	11	BLKPLANT	10	11																
11	12	BLKPLANT	12	12																
12	13	BLKPLANT	13	13																
13	14	BLKPLANT	14	14																
14	15	BLKPLANT	16	16																
15	16	BLKPLANT	18	19																
16	17	BLKPLANT	20	20																

Card 62------------------------------------ Cooling Equipment Parameters ---

Cool Ref Num	Equip Code Name	Num Of Units	------------COOLING------------ --Capacity-- Value	Units	----Energy---- Value	Units	---------HEAT RECOVERY---------- --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	100ACREC	1	40	TONS	70.4	KW							
2	100ACREC	1	50	TONS	88	KW							
3	100ACREC	1	40	TONS	70.4	KW							
4	100ACREC	1	25	TONS	44	KW							
5	100ACREC	1	30	TONS	52.8	KW							
6	100ACREC	1	45	TONS	79.2	KW							
7	100ACREC	1	45	TONS	79.2	KW					1	PAR	
8	EQ1161	1	4	TONS	5.81	KW					2	PAR	
9	EQ1161	1	46	TONS	67.6	KW							
10	100ACREC	1	40	TONS	70.4	KW							
11	100ACREC	1	50	TONS	88	KW							
12	100ACREC	1	50	TONS	88	KW							
13	100ACREC	1	10	TONS	17.6	KW							
14	100ACREC	1	15	TONS	26.4	KW							
15	EQ1161	1	4.5	TONS	8.48	KW							
16	100ACREC	1	100	TONS	176	KW							
17	100ACREC	1	10	TONS	17.6	KW							

Card 63------------------------------ Cooling Pumps and References ------------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	2.24	KW								3
2	2.24	KW								5
3	1.12	KW								
4	1.12	KW								
5	.37	KW								
6	2.24	KW								
7	2.24	KW								
10	1.12	KW								
11	3.73	KW								
12	1.49	KW								
13	1.12	KW								
14	1.49	KW								
16	5.6	KW								
17	.75	KW								

Card 65-- Heating Load Assignment --

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	1	1																
2	2	2	2	15	15														
3	3	3	3																
4	4	4	4																
5	5	5	5	17	17														
6	6	6	6																
7	7	7	7																
8	8	8	8																
9	9	9	9																
10	10	10	10																
11	11	11	11																
12	12	12	12																
13	13	13	13																
14	14	14	14																
15	15	16	16																
16	16	18	19																
17	18	20	20																

Card 67--------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	BOILERWT	1	1.12	KW	618	MBH	850	MBH				2		
2	BOILERWT	1	1.12	KW	618	MBH	850	MBH				4		
3	BOILERWT	1	0.37	KW	109	MBH	150	MBH						
4	BOILERWT	1	.37	KW	109	MBH	150	MBH				1		
5	BOILERWT	1	.37	KW	596	MBH	820	MBH						

Card 67------------------------------------- Heating Equipment Parameters ---

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
6	BOILERWT	1	.75	KW	596	MBH	820	MBH						
7	BOILERWT	1	.75	KW	596	MBH	820	MBH						
8	EQ2454	1			515.2	MBH	53.59	KW						
9	BOILERWT	1	.75	KW	596	MBH	820	MBH						
10	BOILERWT	1	.75	KW	596	MBH	820	MBH						
11	BOILERWT	1	.75	KW	596	MBH	820	MBH						
12	BOILERWT	1	.75	KW	1273	MBH	1750	MBH						
13	BOILERWT	1	.56	KW	327	MBH	450	MBH						
14	BOILERWT	1	1.12	KW	145	MBH	200	MBH						
15	EQ2454	1			33	MBH	45	MBH						
16	STEAMBLR	1			727	MBH	1000	MBH	1					
17	STEAMBLR	1			727	MBH	1000	MBH	2					
18	BOILERWT	1	.37	KW	327	MBH	450	MBH						

Card 71-------------------------------- Base Utility Parameters -------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP HT LOS	1.2	TONS	FTSAMCLG	CHILL-LD	1			
2	PIPE HT LOS	10.98	MBH	FTSAMHTG	HOT-LD	1			
3	PIPE-PUMP HT LOS	1.32	TONS	FTSAMCLG	CHILL-LD	2			
4	PIPE HT LOSS	12.81	MBH	FTSAMHTG	HOT-LD	2			
5	PIPE-PUMP HT LOS	1.03	TONS	FTSAMCLG	CHILL-LD	3			
6	PIPE HT LOSS	13.64	MBH	FTSAMHTG	HOT-LD	3			
7	PIPE-PUMP HT LOS	.83	TONS	FTSAMCLG	CHILL-LD	4			
8	PIPE HT LOSS	10.14	MBH	FTSAMHTG	HOT-LD	4			
9	PIPE-PUMP HT LOS	.89	TONS	FTSAMCLG	CHILL-LD	5			
10	PIPE HT LOSS	6.67	MBH	FTSAMHTG	HOT-LD	5			
11	PIPE-PUMP HT LOS	1.4	TONS	FTSAMCLG	CHILL-LD	6			
12	PIPE HT LOS	10.21	MBH	FTSAMHTG	HOT-LD	6			
13	PIPE-PUMP HT LOS	1.4	TONS	FTSAMCLG	CHILL-LD	7			
14	PIPE HT LOSS	10.21	MBH	FTSAMHTG	HOT-LD	7			
15	COMPR HEAT	1.5	TONS	FTSAMCLG	CHILL-LD	9			
16	REFRIG. HT LOSS	10.2	MBH	FTSAMHTG	HOT-LD	8			
17	PIPE-PUMP HT LOS	1.09	TONS	FTSAMCLG	CHILL-LD	10			
18	PIPE HT LOSS	10.21	MBH	FTSAMHTG	HOT-LD	9			
19	PIPE-PUMP HT LOS	1.98	TONS	FTSAMCLG	CHILL-LD	11			
20	PIPE HT LOSS	10.07	MBH	FTSAMHTG	HOT-LD	10			
21	PIPE HT LOSS	10.07	MBH	FTSAMHTG	HOT-LD	11			
22	PIPE-PUMP HT LOS	1.14	TONS	FTSAMCLG	CHILL-LD	12			
23	PIPE HT LOSS	9.12	MBH	FTSAMHTG	HOT-LD	12			
24	PIPE-PUMP HT LOS	.53	TONS	FTSAMCLG	CHILL-LD	13			
25	PIPE HT LOSS	3.03	MBH	FTSAMHTG	HOT-LD	13			
26	PIPE-PUMP HT LOS	0.72	TONS	FTSAMCLG	CHILL-LD	14			
27	PIPE HT LOSS	5.5	MBH	FTSAMHTG	HOT-LD	14			

Card 71------------------------------- Base Utility Parameters -----------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
28	PIPE HT LOSS	.11	TONS	FTSAMCLG	CHILL-LD	15			
29	PIPE HT LOSS	1.83	MBH	FTSAMHTG	HOT-LD	15			
30	PIPE-PUMP HT LOS	3	TONS	FTSAMCLG	CHILL-LD	16			
31	PIPE HT LOSS	22.8	MBH	FTSAMHTG	HOT-LD	16			
32	PIPE-PUMP HT LOS	.39	TONS	FTSAMCLG	CHILL-LD	17			
33	PIPE HT LOSS	3.32	MBH	FTSAMHTG	HOT-LD	18			

Card 75------------------------------------ Miscellaneous Accessory --

Misc Ref	#1 Equip Code	Energy Value	Energy Units	Sched Code	#2 Equip Code	Energy Value	Energy Units	Sched Code	#3 Equip Code	Energy Value	Energy Units	Sched Code
1	EQ5240	3.73	KW									
2	EQ5020	1.12	KW									
3	EQ5001	2.24	KW									
4	EQ5020	1.12	KW									
5	EQ5001	2.24	KW									

-------------------- Equipment Section Alternative #2 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
2				AIR COOLED SINGLE SCREW CHILLERS		

Card 60--- Cooling Load Assignment---

Load Asgn Ref	All Coil Loads To Cool Ref	Cooling Equipment Sizing	-Group 1- Begin	End	-Group 2- Begin	End	-Group 3- Begin	End	-Group 4- Begin	End	-Group 5- Begin	End	-Group 6- Begin	End	-Group 7- Begin	End	-Group 8- Begin	End	-Group 9- Begin	End
1	1	BLKPLANT	1	20																

Card 62---------------------------------- Cooling Equipment Parameters --

Cool Ref Num	Equip Code Name	Num Of Units	COOLING --Capacity-- Value	Units	----Energy---- Value	Units	HEAT RECOVERY --Capacity-- Value	Units	----Energy---- Value	Units	Seq Order Num	Seq Type	Demand Limit Number
1	EQ1510	1	210	TONS	240	KW					1	PAR	
2	EQ1510	1	210	TONS	240	KW					2	PAR	

Card 63---------------------------- Cooling Pumps and References ----------------------------------

Cool Ref Num	---CHILLED WATER---- Full Load Value	Full Load Units	-----CONDENSER------ Full Load Value	Full Load Units	---HT REC or AUX---- Full Load Value	Full Load Units	Switch-over Control	Cold Storage	Cooling Tower	Misc. Access.
1	22.38	KW							1	
2	22.38	KW							1	

Card 71-------------------------------- Base Utility Parameters ------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE-PUMP LOSS	18.53	TONS	FTSAMCLG	CHILL-LD	1			

Card 74---------------------------- Condenser / Cooling Tower Parameters --------------------------------

Tower Ref	Cooling Tower Code	Capacity Value	Capacity Units	Energy Consump Value	Energy Consump Units	Fluid Type	Tower Type	Number Of Cells	Percent Airflow Low Spd	Low Spd Energy Value	Low Spd Energy Units
1	EQ5200			0	KW						

-------------------- Equipment Section Alternative #3 --------------------

Card 59---------------------------- Equipment Description / TOD Schedules ----------------------------------

Alternative Number	Elec Consump Time of Day Schedule	Elec Demand Time of Day Schedule	Demand Limit Max KW	Alternative Description	---- Demand Limit --- Schedule	Temperature Drift
3				NATURAL DRAFT WATER TUBE BOILERS		

Card 65--------------------------------------- Heating Load Assignment ---

Load Assignment Reference	All Coil Loads To Heating Ref	-Group 1- Begin End	-Group 2- Begin End	-Group 3- Begin End	-Group 4- Begin End	-Group 5- Begin End	-Group 6- Begin End	-Group 7- Begin End	-Group 8- Begin End	-Group 9- Begin End
1	1	1 20								

Card 67--------------------------------------- Heating Equipment Parameters --

Heat Ref Number	Equip Code Name	Number Of Units	HW Pmp Full Ld Value	Units	Cap'y Value	Units	Energy Rate Value	Units	Seq Order Number	Switch over Control	Hot Strg	Misc. Acc.	Cogen	Demand Limit Number
1	BOILERWT	1	7.46	KW	563	MBH	750	MBH	1	1				
2	BOILERWT	1	11.19	KW	1250	MBH	1666	MBH	2	1				

Card 71---------------------------------- Base Utility Parameters ---------------------------------------

Base Utility Number	Base Utility Descrip	Hourly Demand Value	Hourly Demand Units	Schedule Code	Energy Type	Equip Reference Number	Demand Limiting Number	Entering Temp	Leaving Temp
1	PIPE HT LOSS	49.92	MBH	FTSAMHTG	HOT-LD	1			
2	PIPE HT LOSS	110.89	MBH	FTSAMHTG	HOT-LD	2			

Card 72-- Switchover Controls ---------

Control Reference	Load Value	Load Units	Outside Air DB	Sched Code
1	750	MBH		

Utility Description Reference Table

```
    Schedules:
         FSHBARRL  F.S.H. BARRACKS LIGHT/MISC.  SCHEDULE
         FSHBARRP  F.S.H. BARRACKS PEOPLE SCHEDULE
         FSHOFFIC  F.S.H. OFFICE INTERNAL LOAD SCHEDULE
         FTSAMCLG  EEAP BOILER/CHILLER STUDY
         FTSAMHTG  EEAP BOILER/CHILLER STUDY
         OFF  ALWAYS OFF
    System:
         MZ  MULTIZONE
         SZ  SINGLE ZONE
    Equipment:
         Cooling:
              100ACREC  AREA 100 EXIST AIR COOLED RECIP CHILLR
              EQ1161  AIR COOLED COND COMP < 15 TONS
              EQ1510  AIR COOLED SERIES R (RTAA)
         Heating:
              BOILERWT  WATERTUBE BOILER
              EQ2454  RESIDENTIAL GAS FURNACE WITH FAN
              STEAMBLR  GAS FIRED STEAM BOILER
              Tower:
                   EQ5200  CONDENSER FANS
            Misc:
               EQ5001  CHILLED WATER PUMP -  CONSTANT VOLUME
               EQ5020  HEATING WATER CIRCULATION PUMP
               EQ5240  BOILER FORCED DRAFT FAN
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**                                                                         **
**                  T R A C E   6 0 0   A N A L Y S I S                    **
**                                                                         **
**                  by  HUITT & ZOLLARS                                    **
**                                                                         **
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030185.04 EEAP BOILER-CHILLER STUDY
FT. SAM HOUSTON - SAN ANTONIO, TX.
CORPS. OF ENGINEERS - FORT WORTH, TX.
HUITT-ZOLLARS INC.
AREA 100

Weather File Code:		
Location:	SAN ANTONIO, TEXAS	
Latitude:	29.0	(deg)
Longitude:	98.0	(deg)
Time Zone:	6	
Elevation:	792	(ft)
Barometric Pressure:	29.0	(in. Hg)
Summer Clearness Number:	0.90	
Winter Clearness Number:	0.90	
Summer Design Dry Bulb:	97	(F)
Summer Design Wet Bulb:	76	(F)
Winter Design Dry Bulb:	30	(F)
Summer Ground Relectance:	0.20	
Winter Ground Relectance:	0.20	
Air Density:	0.0738	(Lbm/cuft)
Air Specific Heat:	0.2444	(Btu/lbm/F)
Density-Specific Heat Prod:	1.0818	(Btu-min./hr/cuft/F)
Latent Heat Factor:	4,761.9	(Btu-min./hr/cuft)
Enthalpy Factor:	4.4255	(Lb-min./hr/cuft)

Design Simulation Period: June To November
System Simulation Period: January To December
Cooling Load Methodology: TETD/Time Averaging

Time/Date Program was Run: 12:36: 0 6/12/95
Dataset Name: FSH100 .TM

SYSTEM TOTALS LOAD PROFILE - ALTERNATIVE 1
AREA 100 EXISTING SYSTEMS

---------- S Y S T E M   L O A D   P R O F I L E ----------

System Totals

Percent Design Load	Cooling Load Cap. (Ton)	Cooling Load Hours (%)	Cooling Load Hours	Heating Load Capacity (Btuh)	Heating Load Hours (%)	Heating Load Hours
0 - 5	25.3	8	360	-162,580	43	972
5 - 10	50.5	12	510	-325,160	29	650
10 - 15	75.8	11	495	-487,740	8	176
15 - 20	101.1	8	347	-650,319	5	106
20 - 25	126.3	7	290	-812,899	3	64
25 - 30	151.6	7	325	-975,479	3	68
30 - 35	176.9	7	298	-1,138,059	3	73
35 - 40	202.1	8	351	-1,300,639	3	62
40 - 45	227.4	7	297	-1,463,218	2	53
45 - 50	252.6	7	298	$\boxed{-1,625,798}$	1	29
50 - 55	277.9	4	194	-1,788,378	0	0
55 - 60	303.2	4	169	-1,950,958	0	0
60 - 65	328.4	3	149	-2,113,538	0	0
65 - 70	353.7	4	171	-2,276,118	0	0
70 - 75	379.0	1	22	-2,438,698	0	0
75 - 80	$\boxed{404.2}$	2	86	-2,601,278	0	0
80 - 85	429.5	0	0	-2,763,858	0	0
85 - 90	454.8	0	0	-2,926,437	0	0
90 - 95	480.0	0	0	-3,089,017	0	0
95 - 100	505.3	0	0	-3,251,597	0	0
Hours Off	0.0	0	4,398	0	0	6,507

UIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
SE CASE

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
0	LIGHTS													
	ELEC	99030	89550	105452	94800	102241	101222	95819	105452	94800	102241	94800	95819	1,181,224
	PK	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1		BASE UTILITY												
	CHILLD	0	0	0	0	893	864	893	893	864	893	0	0	5,299
	PK	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	0.0	0.0	1.2
2		BASE UTILITY												
	HOTLD	82	74	82	79	0	0	0	0	0	0	79	82	477
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
3		BASE UTILITY												
	CHILLD	0	0	0	0	982	950	982	982	950	982	0	0	5,829
	PK	0.0	0.0	0.0	0.0	1.3	1.3	1.3	1.3	1.3	1.3	0.0	0.0	1.3
4		BASE UTILITY												
	HOTLD	95	86	95	92	0	0	0	0	0	0	92	95	556
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

---------------------------------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
5			BASE UTILITY											
	CHILLD	0	0	0	0	766	742	766	766	742	766	0	0	4,548
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
6			BASE UTILITY											
	HOTLD	101	92	101	98	0	0	0	0	0	0	98	101	593
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
7			BASE UTILITY											
	CHILLD	0	0	0	0	618	598	618	618	598	618	0	0	3,665
	PK	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.8
8			BASE UTILITY											
	HOTLD	75	68	75	73	0	0	0	0	0	0	73	75	440
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
9			BASE UTILITY											
	CHILLD	0	0	0	0	662	641	662	662	641	662	0	0	3,930
	PK	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9	0.9	0.9	0.0	0.0	0.9
10			BASE UTILITY											
	HOTLD	50	45	50	48	0	0	0	0	0	0	48	50	290
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
11			BASE UTILITY											
	CHILLD	0	0	0	0	1042	1008	1042	1042	1008	1042	0	0	6,182
	PK	0.0	0.0	0.0	0.0	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	1.4
12			BASE UTILITY											
	HOTLD	76	69	76	74	0	0	0	0	0	0	74	76	444
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
13			BASE UTILITY											
	CHILLD	0	0	0	0	1042	1008	1042	1042	1008	1042	0	0	6,182
	PK	0.0	0.0	0.0	0.0	1.4	1.4	1.4	1.4	1.4	1.4	0.0	0.0	1.4
14			BASE UTILITY											
	HOTLD	76	69	76	74	0	0	0	0	0	0	74	76	444
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
15			BASE UTILITY											
	CHILLD	0	0	0	0	1116	1080	1116	1116	1080	1116	0	0	6,624
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	1.5

'IPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
16			BASE UTILITY											
	HOTLD	76	69	76	73	0	0	0	0	0	0	73	76	443
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
17			BASE UTILITY											
	CHILLD	0	0	0	0	811	785	811	811	785	811	0	0	4,813
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
18			BASE UTILITY											
	HOTLD	76	69	76	74	0	0	0	0	0	0	74	76	444
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
19			BASE UTILITY											
	CHILLD	0	0	0	0	1473	1426	1473	1473	1426	1473	0	0	8,744
	PK	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	2.0
20			BASE UTILITY											
	HOTLD	75	68	75	73	0	0	0	0	0	0	73	75	437
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
21			BASE UTILITY											
	HOTLD	75	68	75	73	0	0	0	0	0	0	73	75	437
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
22			BASE UTILITY											
	CHILLD	0	0	0	0	848	821	848	848	821	848	0	0	5,034
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
23			BASE UTILITY											
	HOTLD	68	61	68	66	0	0	0	0	0	0	66	68	396
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
24			BASE UTILITY											
	CHILLD	0	0	0	0	394	382	394	394	382	394	0	0	2,340
	PK	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.5
25			BASE UTILITY											
	HOTLD	23	20	23	22	0	0	0	0	0	0	22	23	132
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26			BASE UTILITY											
	CHILLD	0	0	0	0	536	518	536	536	518	536	0	0	3,180
	PK	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.0	0.0	0.7

'IPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
						Monthly Consumption								
27			BASE UTILITY											
	HOTLD	41	37	41	40	0	0	0	0	0	0	40	41	239
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
28			BASE UTILITY											
	CHILLD	0	0	0	0	82	79	82	82	79	82	0	0	486
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
29			BASE UTILITY											
	HOTLD	14	12	14	13	0	0	0	0	0	0	13	14	79
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30			BASE UTILITY											
	CHILLD	0	0	0	0	2232	2160	2232	2232	2160	2232	0	0	13,248
	PK	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0	3.0
31			BASE UTILITY											
	HOTLD	170	153	170	164	0	0	0	0	0	0	164	170	990
	PK	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2
32			BASE UTILITY											
	CHILLD	0	0	0	0	290	281	290	290	281	290	0	0	1,722
	PK	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.4
33			BASE UTILITY											
	HOTLD	25	22	25	24	0	0	0	0	0	0	24	25	144
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			AREA 100 EXIST AIR COOLED RECIP CHILLR											
	ELEC	0	0	0	0	12971	17212	21161	21472	14265	5314	0	0	$\boxed{92,395}$
	PK	0.0	0.0	0.0	0.0	47.5	53.0	56.9	56.3	47.8	35.0	0.0	0.0	56.9
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	$\boxed{9,892}$
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2
1	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	$\boxed{9,892}$
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	16071	21001	25828	26166	17429	6417	0	0	112,912
	PK	0.0	0.0	0.0	0.0	58.3	64.4	69.1	68.0	57.9	42.2	0.0	0.0	69.1
2	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,892
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2
2	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
2	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,892
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2
3		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	1988	1982	2111	2106	1941	1917	0	0	12,045
	PK	0.0	0.0	0.0	0.0	28.4	29.7	30.8	30.6	28.6	26.3	0.0	0.0	30.8
3	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4,946
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
3	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
4		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	11076	14142	17246	17487	12190	4633	0	0	76,773
	PK	0.0	0.0	0.0	0.0	37.5	42.4	44.8	44.4	38.6	27.0	0.0	0.0	44.8
4	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4,946
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
4	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
5		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	15584	18461	21788	22374	16854	8963	0	0	104,024
	PK	0.0	0.0	0.0	0.0	49.6	51.8	53.8	53.3	49.8	45.5	0.0	0.0	53.8

'JIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
5	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	275	266	275	275	266	275	0	0	1,634
	PK	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.4	0.4	0.4	0.0	0.0	0.4
5	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
6			AREA 100 EXIST AIR COOLED RECIP CHILLR											
	ELEC	0	0	0	0	16505	20599	24401	25104	18009	9158	0	0	113,775
	PK	0.0	0.0	0.0	0.0	61.4	66.6	71.5	72.2	62.9	49.7	0.0	0.0	72.2
6	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,892
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2
6	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
7			AREA 100 EXIST AIR COOLED RECIP CHILLR											
	ELEC	0	0	0	0	16505	20599	24401	25104	18009	9158	0	0	113,775
	PK	0.0	0.0	0.0	0.0	61.4	66.6	71.5	72.2	62.9	49.7	0.0	0.0	72.2
7	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	1667	1613	1667	1667	1613	1667	0	0	9,892
	PK	0.0	0.0	0.0	0.0	2.2	2.2	2.2	2.2	2.2	2.2	0.0	0.0	2.2
7	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
8	EQ1161		AIR COOLED COND COMP < 15 TONS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	EQ5200		CONDENSER FANS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	EQ5303		CONTROLS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
..SE CASE

---------- E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ----------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
9	EQ1161		AIR COOLED COND COMP < 15 TONS											
	ELEC	0	0	0	0	9349	11812	14056	14784	10019	4806	0	0	64,825
	PK	0.0	0.0	0.0	0.0	63.6	66.4	68.8	68.3	63.8	58.9	0.0	0.0	68.8
9	EQ5200		CONDENSER FANS											
	ELEC	0	0	0	0	910	1147	1607	1421	987	452	0	0	6,524
	PK	0.0	0.0	0.0	0.0	4.5	4.8	6.2	6.2	4.6	3.6	0.0	0.0	6.2
9	EQ5303		CONTROLS											
	ELEC	0	0	0	0	223	216	223	223	216	223	0	0	1,325
	PK	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.3
10			AREA 100 EXIST AIR COOLED RECIP CHILLR											
	ELEC	0	0	0	0	15535	19517	23118	23816	17025	8376	0	0	107,387
	PK	0.0	0.0	0.0	0.0	59.0	64.1	68.9	69.7	60.6	47.5	0.0	0.0	69.7
10	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4,946
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
10	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
11			AREA 100 EXIST AIR COOLED RECIP CHILLR											
	ELEC	0	0	0	0	25325	31101	37574	37169	27737	11449	0	0	170,355
	PK	0.0	0.0	0.0	0.0	70.0	76.4	85.0	83.4	74.2	56.3	0.0	0.0	85.0
11	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	2775	2686	2775	2775	2686	2775	0	0	16,472
	PK	0.0	0.0	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	0.0	0.0	3.7
11	EQ5300		CONTROL PANEL & INTERLOCKS											
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
12			AREA 100 EXIST AIR COOLED RECIP CHILLR											
	ELEC	0	0	0	0	16906	20372	24091	24748	17920	9344	0	0	113,383
	PK	0.0	0.0	0.0	0.0	60.4	65.5	70.3	70.6	61.9	49.6	0.0	0.0	70.6
12	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	1109	1073	1109	1109	1073	1109	0	0	6,580
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	1.5

'IPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
12	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
13		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	4477	5511	6556	6721	4884	2466	0	0	30,616
	PK	0.0	0.0	0.0	0.0	16.1	17.3	17.9	17.8	16.6	12.9	0.0	0.0	17.9
13	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	833	806	833	833	806	833	0	0	4,946
	PK	0.0	0.0	0.0	0.0	1.1	1.1	1.1	1.1	1.1	1.1	0.0	0.0	1.1
13	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
14		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	6115	7877	9643	9951	6902	2830	0	0	43,319
	PK	0.0	0.0	0.0	0.0	21.6	23.9	26.2	26.6	22.6	16.0	0.0	0.0	26.6
14	EQ5001	CHILLED WATER PUMP - CONSTANT VOLUME												
	ELEC	0	0	0	0	1109	1073	1109	1109	1073	1109	0	0	6,580
	PK	0.0	0.0	0.0	0.0	1.5	1.5	1.5	1.5	1.5	1.5	0.0	0.0	1.5
14	EQ5300	CONTROL PANEL & INTERLOCKS												
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
15	EQ1161	AIR COOLED COND COMP < 15 TONS												
	ELEC	0	0	0	0	1705	2262	2879	2931	1893	562	0	0	12,232
	PK	0.0	0.0	0.0	0.0	8.0	8.3	8.6	8.6	8.0	7.4	0.0	0.0	8.6
15	EQ5200	CONDENSER FANS												
	ELEC	0	0	0	0	140	184	243	238	157	45	0	0	1,008
	PK	0.0	0.0	0.0	0.0	0.6	0.7	0.7	0.7	0.6	0.4	0.0	0.0	0.7
15	EQ5303	CONTROLS												
	ELEC	0	0	0	0	223	216	223	223	216	223	0	0	1,325
	PK	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.3	0.3	0.0	0.0	0.3
16		AREA 100 EXIST AIR COOLED RECIP CHILLR												
	ELEC	0	0	0	0	55068	61582	70144	71148	58363	30555	0	0	346,860
	PK	0.0	0.0	0.0	0.0	117.2	122.9	133.5	137.3	118.3	87.7	0.0	0.0	137.3

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
16	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	4166	4032	4166	4166	4032	4166	0	0	24,730
	PK	0.0	0.0	0.0	0.0	5.6	5.6	5.6	5.6	5.6	5.6	0.0	0.0	5.6
16	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
17				AREA 100 EXIST AIR COOLED RECIP CHILLR										
	ELEC	0	0	0	0	3737	5121	6202	6182	3955	1429	0	0	26,626
	PK	0.0	0.0	0.0	0.0	13.8	15.3	16.5	16.7	14.0	9.8	0.0	0.0	16.7
17	EQ5001			CHILLED WATER PUMP - CONSTANT VOLUME										
	ELEC	0	0	0	0	558	540	558	558	540	558	0	0	3,312
	PK	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.8	0.8	0.8	0.0	0.0	0.8
17	EQ5300			CONTROL PANEL & INTERLOCKS										
	ELEC	0	0	0	0	744	720	744	744	720	744	0	0	4,416
	PK	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	0.0	0.0	1.0
1				WATERTUBE BOILER										
	GAS	506	499	160	109	0	0	0	0	0	0	172	481	1,928
	PK	1.8	2.0	1.1	0.3	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.8	2.0
1	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	678	635	484	403	0	0	0	0	0	0	491	687	3,377
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1
1	EQ5311			BOILER CONTROLS										
	ELEC	76	71	54	45	0	0	0	0	0	0	55	77	377
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
1	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,865
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1
2				WATERTUBE BOILER										
	GAS	600	578	184	127	0	0	0	0	0	0	203	571	2,263
	PK	2.1	2.3	1.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.1	2.3
2	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,865
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
		Monthly Consumption												
2	EQ5311		BOILER CONTROLS											
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,865
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1
3			WATERTUBE BOILER											
	GAS	140	126	140	135	0	0	0	0	0	0	135	140	815
	PK	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2
3	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	275	249	275	266	0	0	0	0	0	0	266	275	1,607
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
3	EQ5311		BOILER CONTROLS											
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
4			WATERTUBE BOILER											
	GAS	480	454	137	100	0	0	0	0	0	0	152	447	1,769
	PK	1.5	1.5	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.5	1.5
4	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	275	249	275	266	0	0	0	0	0	0	266	275	1,607
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
4	EQ5311		BOILER CONTROLS											
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
4	EQ5240		BOILER FORCED DRAFT FAN											
	ELEC	2775	2507	2775	2686	0	0	0	0	0	0	2686	2775	16,203
	PK	3.7	3.7	3.7	3.7	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.7	3.7
5			WATERTUBE BOILER											
	GAS	188	172	78	66	0	0	0	0	0	0	79	175	757
	PK	1.3	1.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.3	1.4
5	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	212	194	148	133	0	0	0	0	0	0	144	208	1,039
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
..SE CASE

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
5	EQ5311			BOILER CONTROLS										
	ELEC	72	66	50	45	0	0	0	0	0	0	48	70	351
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
6				WATERTUBE BOILER										
	GAS	276	273	119	101	0	0	0	0	0	0	112	245	1,124
	PK	1.7	1.8	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	1.8
6	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	360	338	297	270	0	0	0	0	0	0	290	349	1,904
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8
6	EQ5311			BOILER CONTROLS										
	ELEC	60	56	49	45	0	0	0	0	0	0	48	58	317
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
7				WATERTUBE BOILER										
	GAS	276	273	119	101	0	0	0	0	0	0	112	245	1,124
	PK	1.7	1.8	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	1.8
7	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	360	338	297	270	0	0	0	0	0	0	290	349	1,904
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8
7	EQ5311			BOILER CONTROLS										
	ELEC	60	56	49	45	0	0	0	0	0	0	48	58	317
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
8	EQ2454			RESIDENTIAL GAS FURNACE WITH FAN										
	GAS	85	83	37	26	0	0	0	0	0	0	36	78	345
	PK	0.5	0.5	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.5
8	EQ5254			RESIDENTIAL FURNACE FAN										
	ELEC	5758	5157	4670	4080	0	0	0	0	0	0	4624	5713	30,002
	PK	11.3	11.3	11.3	11.3	0.0	0.0	0.0	0.0	0.0	0.0	11.3	11.3	11.3
9				WATERTUBE BOILER										
	GAS	276	273	119	101	0	0	0	0	0	0	112	245	1,124
	PK	1.7	1.8	0.8	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.7	1.8
9	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	360	338	297	270	0	0	0	0	0	0	290	349	1,904
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
9	EQ5311		BOILER CONTROLS											
	ELEC	60	56	49	45	0	0	0	0	0	0	48	58	317
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
10			WATERTUBE BOILER											
	GAS	294	306	103	100	0	0	0	0	0	0	100	258	1,161
	PK	1.5	1.6	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	1.6
10	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	466	415	279	270	0	0	0	0	0	0	270	436	2,136
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8
10	EQ5311		BOILER CONTROLS											
	ELEC	78	69	47	45	0	0	0	0	0	0	45	73	356
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
11			WATERTUBE BOILER											
	GAS	294	306	103	100	0	0	0	0	0	0	100	258	1,161
	PK	1.5	1.6	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	1.5	1.6
11	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	466	415	279	270	0	0	0	0	0	0	270	436	2,136
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8
11	EQ5311		BOILER CONTROLS											
	ELEC	78	69	47	45	0	0	0	0	0	0	45	73	356
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
12			WATERTUBE BOILER											
	GAS	219	207	94	90	0	0	0	0	0	0	91	190	892
	PK	1.5	1.5	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.5	1.5
12	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	240	235	186	180	0	0	0	0	0	0	180	235	1,257
	PK	0.8	0.8	0.8	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8
12	EQ5311		BOILER CONTROLS											
	ELEC	40	39	31	30	0	0	0	0	0	0	30	39	210
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
13			WATERTUBE BOILER											
	GAS	93	89	37	30	0	0	0	0	0	0	38	88	375
	PK	0.5	0.6	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.6

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
13	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	225	209	157	134	0	0	0	0	0	0	161	219	1,106
	PK	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.6	0.6
13	EQ5311	BOILER CONTROLS												
	ELEC	50	47	35	30	0	0	0	0	0	0	36	49	247
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
14		WATERTUBE BOILER												
	GAS	261	252	82	55	0	0	0	0	0	0	91	252	994
	PK	1.0	1.0	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.0	1.0
14	EQ5020	HEATING WATER CIRCULATION PUMP												
	ELEC	833	753	833	806	0	0	0	0	0	0	806	833	4,865
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1
14	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
15	EQ2454	RESIDENTIAL GAS FURNACE WITH FAN												
	GAS	97	91	29	18	0	0	0	0	0	0	31	92	358
	PK	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3
15	EQ5254	RESIDENTIAL FURNACE FAN												
	ELEC	540	488	540	523	0	0	0	0	0	0	523	540	3,154
	PK	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7
16		GAS FIRED STEAM BOILER												
	GAS	350	344	233	226	0	0	0	0	0	0	226	339	1,718
	PK	2.2	2.3	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.1	2.3
16	EQ5311	BOILER CONTROLS												
	ELEC	93	84	93	90	0	0	0	0	0	0	90	93	543
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
17		GAS FIRED STEAM BOILER												
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	EQ5311	BOILER CONTROLS												
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

'IIPMENT ENERGY CONSUMPTION - ALTERNATIVE 1
.SE CASE

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
18			WATERTUBE BOILER											
	GAS	149	150	53	33	0	0	0	0	0	0	61	137	583
	PK	0.6	0.6	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.6
18	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	188	182	152	133	0	0	0	0	0	0	162	191	1,008
	PK	0.4	0.4	0.4	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4
18	EQ5311		BOILER CONTROLS											
	ELEC	63	61	52	45	0	0	0	0	0	0	55	65	341
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
AIR COOLED SINGLE SCREW CHILLERS

------------------------------------ E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N ------------------------------------

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	99030	89550	105452	94800	102241	101222	95819	105452	94800	102241	94800	95819	1,181,224
	PK	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	CHILLD	0	0	0	0	13786	13342	13786	13786	13342	13786	0	0	81,829
	PK	0.0	0.0	0.0	0.0	18.5	18.5	18.5	18.5	18.5	18.5	0.0	0.0	18.5
1	EQ1510		AIR COOLED SERIES R (RTAA)											
	ELEC	0	0	0	0	78520	91045	105093	105495	86547	42216	0	0	508,916
	PK	0.0	0.0	0.0	0.0	210.8	234.2	240.0	240.0	221.0	187.4	0.0	0.0	240.0
1	EQ5200		CONDENSER FANS											
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	16651	16114	16651	16651	16114	16651	0	0	98,830
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 2
AIR COOLED SINGLE SCREW CHILLERS

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5302		CONTROLS											
	ELEC	0	0	0	0	74	72	74	74	72	74	0	0	442
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1
2	EQ1510		AIR COOLED SERIES R (RTAA)											
	ELEC	0	0	0	0	27164	41842	56709	61232	28981	4824	0	0	$\boxed{220,753}$
	PK	0.0	0.0	0.0	0.0	210.8	234.2	240.0	240.0	221.0	147.2	0.0	0.0	240.0
2	EQ5001		CHILLED WATER PUMP - CONSTANT VOLUME											
	ELEC	0	0	0	0	4431	6624	8236	8818	4476	985	0	0	$\boxed{33,570}$
	PK	0.0	0.0	0.0	0.0	22.4	22.4	22.4	22.4	22.4	22.4	0.0	0.0	22.4
2	EQ5302		CONTROLS											
	ELEC	0	0	0	0	20	30	37	39	20	4	0	0	150
	PK	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
NATURAL DRAFT WATER TUBE BOILERS

EQUIPMENT ENERGY CONSUMPTION

Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
0	LIGHTS													
	ELEC	99030	89550	105452	94800	102241	101222	95819	105452	94800	102241	94800	95819	1,181,224
	PK	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1	444.1
1	MISC LD													
	ELEC	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	MISC LD													
	GAS	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	MISC LD													
	OIL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	MISC LD													
	P STEAM	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	MISC LD													
	P HOTH2O	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	MISC LD													
	P CHILL	0	0	0	0	0	0	0	0	0	0	0	0	0
	PK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1			BASE UTILITY											
	HOTLD	371	335	371	359	0	0	0	0	0	0	359	371	2,169
	PK	0.5	0.5	0.5	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5
2			BASE UTILITY											
	HOTLD	825	745	825	798	0	0	0	0	0	0	798	825	4,817
	PK	1.1	1.1	1.1	1.1	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1
1			WATERTUBE BOILER											
	GAS	1753	1911	775	479	0	0	0	0	0	0	834	1807	7,559
	PK	7.5	7.5	7.2	0.7	0.0	0.0	0.0	0.0	0.0	0.0	6.2	7.5	7.5
1	EQ5020		HEATING WATER CIRCULATION PUMP											
	ELEC	5028	4461	5550	5371	0	0	0	0	0	0	5371	5021	30,802
	PK	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	7.5	7.5	7.5

EQUIPMENT ENERGY CONSUMPTION - ALTERNATIVE 3
NATURAL DRAFT WATER TUBE BOILERS

E Q U I P M E N T   E N E R G Y   C O N S U M P T I O N

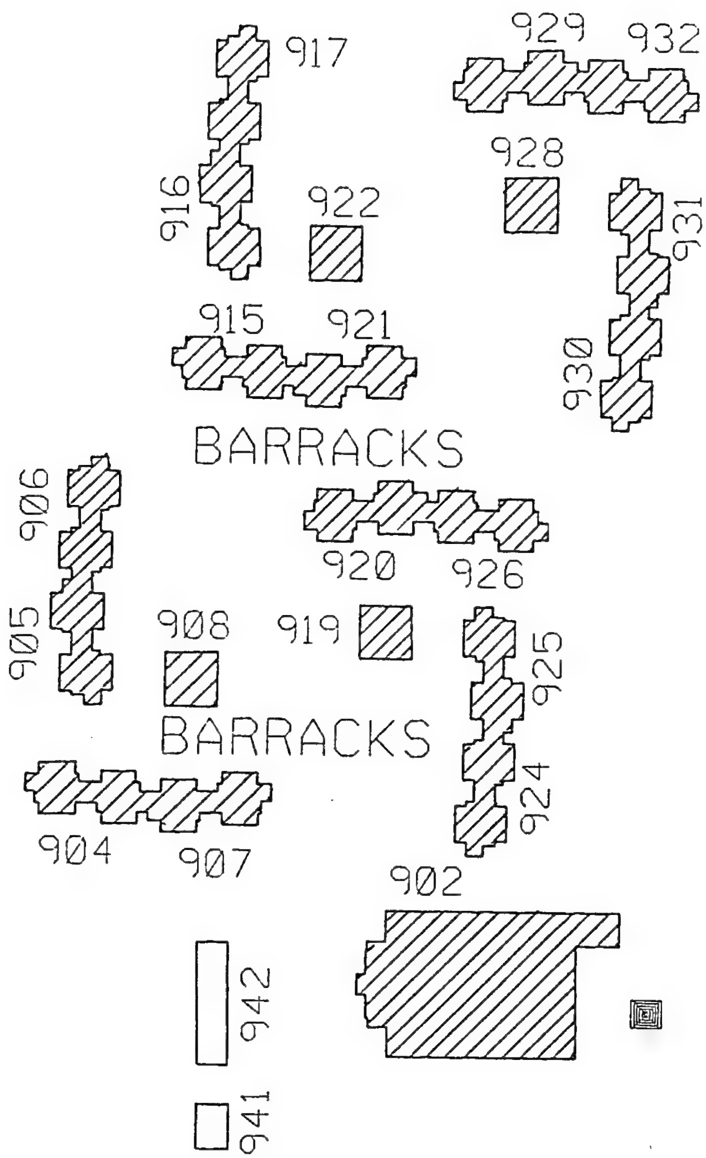
Ref Num	Equip Code	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
1	EQ5311			BOILER CONTROLS										
	ELEC	84	75	93	90	0	0	0	0	0	0	90	84	516
	PK	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
2				WATERTUBE BOILER										
	GAS	1824	1665	0	0	0	0	0	0	0	0	0	1420	4,909
	PK	16.7	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	16.7
2	EQ5020			HEATING WATER CIRCULATION PUMP										
	ELEC	1522	1623	0	0	0	0	0	0	0	0	0	1309	4,454
	PK	11.2	11.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.2	11.2
2	EQ5311			BOILER CONTROLS										
	ELEC	17	18	0	0	0	0	0	0	0	0	0	15	50
	PK	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

APPENDIX C

DATA FORMS

APPENDIX C
DATA FORMS

TABLE OF CONTENTS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925
BARRACKS
924
904
907
902
942
941

BUILDING DESCRIPTION

NAME: Buildings 904, 905, 906, 907, 915, 916, 917, 920, 921, 924, 925, 926, 929, 930, 931, 932

USE: Barracks for single enlisted personnel and attendees of the NCO Academy. Approximately 1 to 3 people per room, and 24 rooms per building. Buildings occupied continuously through the year.

GROSS AREA (SQ.FT.): 11,220 STORIES: 3 DATE OF SURVEY: 11/30 to 12/2/95

DATE OF CONSTRUCTION: 1974

STRUCTURE: Masonry.

EXTERIOR WALLS: Brick

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade.

FLOOR FINISH: Concrete and Carpet.

CEILINGS: Lay-in acoustical tile in hallways and plaster ceilings in personnel rooms.

WINDOWS: single pane, clear glass.

COOLING EQUIP: Two-pipe, horizontal fan coil units in each room and hallway and vertical fan coil units in lounge areas. Units are mostly located above restroom ceilings. There are approximately 23 room units, 6 lounge units and 6 corridor units per building. Units are served by central chiller in building 902.

HEATING EQUIP: See cooling equipment above. Units served by central boiler in building 902.

LIGHTING: Wall mounted incandescent fixtures in quarters and lounges, with lay-in fluorescent fixtures in hallways.

DOMESTIC WATER HEATING: Heat exchanger and 588 gallon storage tank in basement of each building, served by central boilers in building 902.

OTHER: Combination chilled water/heating water pump in each building.

REMARKS: Poor temperature control, extremely hot during field survey. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping distribution system. Leaks and rampant condensation were common throughout all buildings. Corrosion built-up on fan coil units due to placement above restroom ceilings. Also causes accessibility problems for maintenance personnel.

BUILDING DESCRIPTION

NAME: Buildings 908, 919, 922, 928

USE: Buildings 919 & 928 are used for recreation, post office, etc. Average occupancy is 5 persons, between 5 pm till midnight, Monday through Friday, and 9 am till midnight on weekends. Buildings 908 & 922 are used for battalion administration offices, with an average occupancy of 5 persons daily.

GROSS AREA (SQ.FT.): 2,050 STORIES: 1 DATE OF SURVEY: 11/30 to 12/2/95

DATE OF CONSTRUCTION: 1974

STRUCTURE: Masonry.

EXTERIOR WALLS: Brick.

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade.

FLOOR FINISH: Carpet.

CEILINGS: Lay-in acoustical tile.

WINDOWS: Single pane with tempered glass.

COOLING EQUIP: Each building has a four-pipe, central air handling unit for both heating and cooling. Air handlers typically have a 3 HP fan motor. Units are served by central chiller in building 902.

HEATING EQUIP: See cooling equipment above. Units are served by central boiler in building 902.

LIGHTING: Lay-in fluorescent fixtures in open areas, restrooms and offices and recess incandescent lights in hallways.

DOMESTIC WATER HEATING: Electric water heater in each building, 15 gallon, 1250 W each.

OTHER: Combination chilled water/heating water pump in each building, typically 1-1/2 HP each.

REMARKS: Poor temperature control, extremely hot during field survey, doors were opened to control temperatures. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping insulation.

BUILDING DESCRIPTION

NAME: Building 902

USE: Used as administrative offices and classrooms, 7 am until 5 pm, Monday through Friday. Maximum 180 persons when occupied. Other portions used as central boiler and chiller plant for other buildings in the 900 area.

GROSS AREA (SQ.FT.): 23,723 STORIES: 1 DATE OF SURVEY: 11/30 to 12/2/95

DATE OF CONSTRUCTION: 1974

STRUCTURE: Masonry.

EXTERIOR WALLS: Brick.

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade.

FLOOR FINISH: Carpet

CEILINGS: Lay-in acoustical tile

WINDOWS: Single pane with clear glass.

COOLING EQUIP: Two four-pipe central air handlers with individual return air fans are serving the administrative and classroom areas. Units are served by central chiller in building 902.

HEATING EQUIP: See cooling equipment above. Units are served by central boiler in building 902.

LIGHTING: Lay-in fluorescent fixtures in the admin and classrooms, industrial fluorescent fixtures in the storage area, and recess

DOMESTIC WATER HEATING: Heating water to domestic hot water heat exchanger in central plant, served by central boilers in building 902.

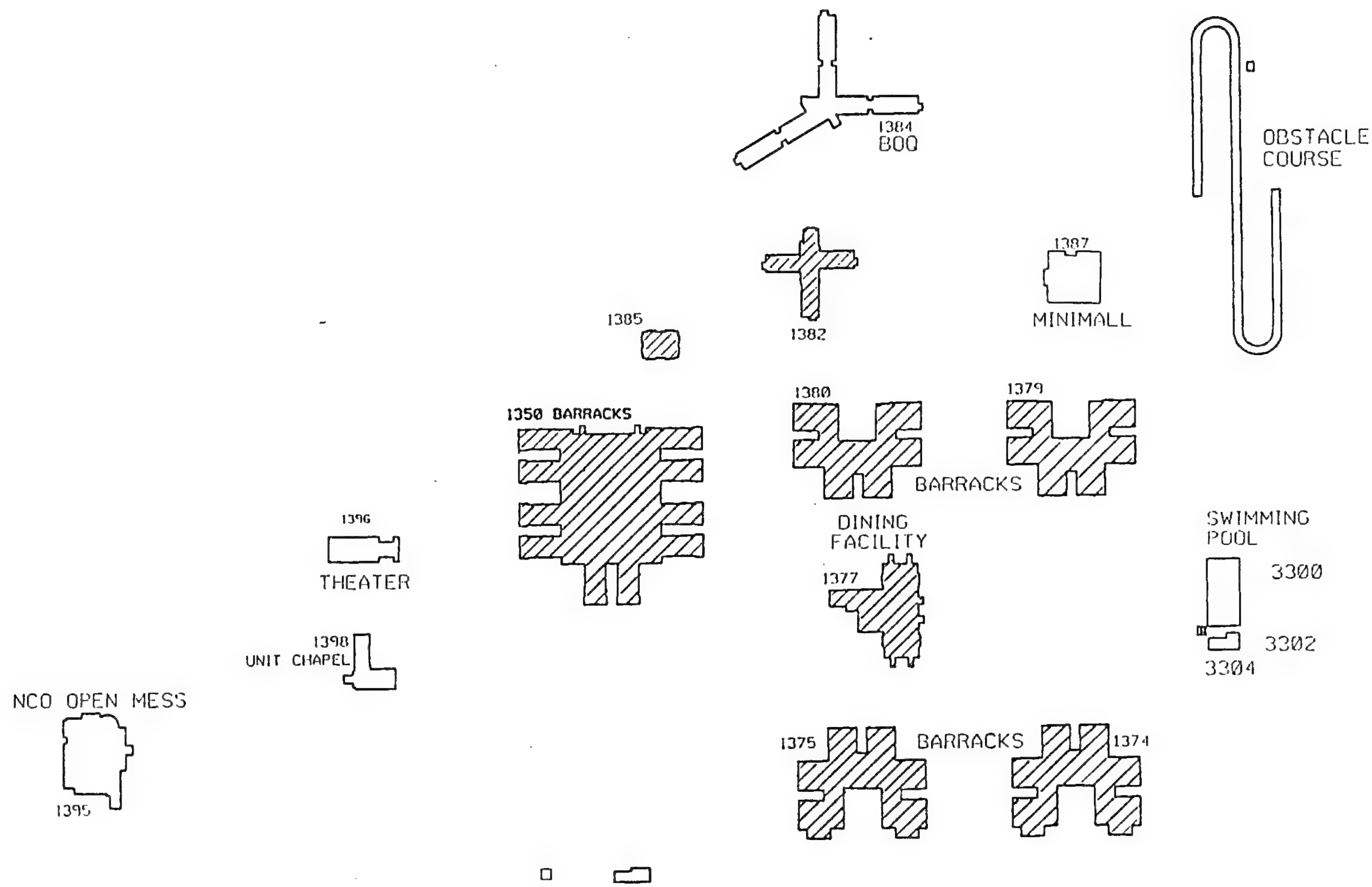
OTHER: Central chiller and boiler equipment, see HVAC Equipment List for descriptions.

REMARKS: Poor temperature control, extremely hot during field survey. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping insulation. Exhaust fans appeared to operate while central AHUs were off. Return air grilles appeared to be excessively dirty. Room remodeling has restricted the return air pattern back to the air handling units.

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 900

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York #YTC303C1CJC water cooled, centrifugal, 304 tons, R-11	Area 900	1985	225 KW	24	7	26	444,056	
Chilled Water Pump	1	Weinman 720 gpm, 100 ft 25 HP	Area 900	1985	18.65 KW	24	7	26	82,358	
Condenser Water Pump	1	Weinman 912 gpm, 50 ft 15 HP	Area 900	1985	11.19 KW	24	7	26	49,415	
Cooling Tower	1	Marley #MC8608 one cell 15 HP fan	Area 900	1979	11.19 KW	24	7	26	45,510	
Hot Water Boiler	3	Ajax #WG 2250 natural draft, watertube 1665 MBH output	Area 900	1979	2,250 MBH	24	7	26		7,809
Heating Water Pump	1	Weinman 200 gpm, 38 ft 5 HP	Area 900	1979	3.73 KW	24	7	26	32,675	
Heating Water Pump	1	Weinman 115 gpm, 30 ft 5 HP	Area 900	1979	3.73 KW	24	7	26	32,675	
Heating Water Pump	1	Weinman 115 gpm, 30 ft 2 HP	Area 900	1979	1.49 KW	24	7	26	13,052	
Heating Water Pump	1	Peerless 1.5 HP	Bldg. 902	1979	1.12 KW	24	7	26	9,811	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COURSE
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MINIMALL
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1379
1350 BARRACKS
BARRACKS
1396
THEATER
DINING
FACILITY
1377
SWIMMING
POOL
3300
3302
3304
1398
UNIT CHAPEL
NCO OPEN MESS
1395
1375
BARRACKS
1374

BUILDING DESCRIPTION

NAME: Building 1350

USE: Barracks, administrative offices, dining and classrooms for single enlisted personnel. Maximum occupancy of 800 persons with current occupancy of 1550 personnel.

GROSS AREA (SQ.FT.): 261,406 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1983

STRUCTURE: Masonry

EXTERIOR WALLS: Both brick and precast panel.

ROOF: Flat built-up roof.

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: Concrete topping, tile, and carpet

CEILINGS: Lay in acoustical tile, plaster, and stucco

WINDOWS: Single pane with glazed, insulating glass.

COOLING EQUIP: Total of seven central multi-zone, variable volume air handling units serving large areas of the building. Approximately 20 two-pipe fan coil units serving cadre rooms. All units are served by central chillers in building 1377.

HEATING EQUIP: See cooling equipment above. Multiple heating/ventilating units serving scrub rooms, toilets and kitchen areas along with heating water convection units serving multiple areas throughout building. All units are served by central boilers in building 1377.

LIGHTING: Lay-in fluorescent fixtures in barracks, admin, classrooms, and dining areas. Surface mounted fluorescent fixtures in kitchen and scattered incandescent fixtures.

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: 7 ½, ½, ½ HP heating water pumps in building. Steam boilers in building serve kitchen equipment.

REMARKS: Poor temperature control, extremely hot during field survey. Piping leaks are a problem. All other HVAC systems appeared to be in fair condition.

BUILDING DESCRIPTION

NAME: Buildings 1374, 1375, 1379, 1380

USE: Barracks for single enlisted personnel, classrooms and administrative offices. Maximum occupancy of approximately 475 people.

GROSS AREA (SQ.FT.): 111,448 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1971

STRUCTURE: Partially exposed structural steel frame

EXTERIOR WALLS: Brick and stucco veneer

ROOF: built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: concrete topping and carpet

CEILINGS: Lay-in acoustical tile in building with stucco over exposed areas

WINDOWS: single pane clear and tempered glass

COOLING EQUIP: Approximately six multi-zone, constant volume central air handlers serving barracks and office areas of the buildings. Approximately four cabinet type fan coil units serving classrooms in the buildings. All units served by central chillers in building 1377.

HEATING EQUIP: See cooling equipment above. All units served by central boilers in building 1377.

LIGHTING: Surface mounted incandescent fixtures in exposed areas. Lay-in fluorescent fixtures in admin and barracks areas.

DOMESTIC WATER HEATING: Gas fired hot water boilers in building to serve restrooms.

OTHER: Secondary 7 ½ and 5 HP chilled/heating water pumps in building.

REMARKS: Poor temperature control, extremely hot during field survey. Renovations to building has caused restricted return air flow back to air handling units. All other HVAC systems appeared to be in fair condition.

BUILDING DESCRIPTION

NAME: Building 1382

USE: Barracks for single enlisted personnel, administrative offices. Continuous occupancy of approximately 240 persons.

GROSS AREA (SQ.FT.): 29,390 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1971

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Flat Built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Gypsum wallboard and acoustical tile

WINDOWS: Single pane clear glass

COOLING EQUIP: Building served by two central multi-zone air handlers. Air handler cooling coils served by central chillers in building 1377.

HEATING EQUIP: See cooling equipment above. Air handler heating coils served by central boilers in building 1377.

LIGHTING: Surface and suspended mounted fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: Secondary 3/4 HP chilled water and ½ HP heating water pumps in building.

REMARKS: Poor temperature control, extremely hot during field survey. All other HVAC systems appeared to be in fair condition. Outside air intake louvers have been blanked off with sheet metal, reducing HVAC loads but also reducing indoor air quality. Building may not meet ASHRAE standards for ventilation.

BUILDING DESCRIPTION

NAME: Building 1385

USE: Administrative services for 232nd Medical Battalion troops. Continuous occupancy of approximately 22 persons.

GROSS AREA (SQ.FT.): 5,072 STORIES: 1 DATE OF SURVEY: 11/30 to 12/2/94

DATE OF CONSTRUCTION: 1971

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Flat built-up roof

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile and gypsum wallboard

WINDOWS: Single pane clear glass

COOLING EQUIP: Building served by central multi-zone air handler in mechanical room. Air handler cooling coil served by central chiller in building 1377.

HEATING EQUIP: See cooling equipment above. Air handler heating coil served by central boiler in building 1377.

LIGHTING: Recessed and surface mounted fluorescent fixtures in office areas and surface mounted incandescent fixtures in other areas

DOMESTIC WATER HEATING: Electric, 66 gallon, 4500 W hot water heater in building to serve restrooms.

OTHER: Secondary 1/4 HP chilled water and 1/8 HP heating water pumps in building.

REMARKS: Poor temperature control, extremely hot during field survey. All other HVAC systems appeared to be in fair condition. Outside air intake louvers have been blanked off with sheet metal, reducing HVAC loads but also reducing indoor air quality. Building may not meet ASHRAE standards for ventilation.

BUILDING DESCRIPTION

NAME: Building 1377

USE: Kitchen and dining hall in building. Other areas serve as central chiller and boiler plant for buildings in 1300 area. Maximum occupancy of 800 persons on weekdays between 4 am and 9 pm.

GROSS AREA (SQ.FT.): 30,350 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1971

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Sloped built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile, gypsum wallboard, and plaster

WINDOWS: single pane clear glass

COOLING EQUIP: Dining areas served by two, single zone, central air handlers in mechanical room. Air handler cooling coils served by central chiller in building 1377. Kitchen served by two evaporative coolers only.

HEATING EQUIP: See cooling equipment above. Air handler heating coil served by central boiler in building 1377. Evaporative coolers serving kitchen have steam htg coil which is supplied by steam boiler in building 1377.

LIGHTING: Surface mounted fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building to serve restrooms.

OTHER: Central chiller and boiler equipment, see HVAC Equipment List for descriptions along with steam boiler to serve bldg. 1377 kitchen equipment..

REMARKS: Poor temperature control, extremely hot during field survey. All mechanical systems appeared to be in a deteriorated state, particularly the HVAC controls and piping insulation. Exhaust fans appeared to operate while central AHUs were off. Return air grilles appeared to be excessively dirty.

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 1300

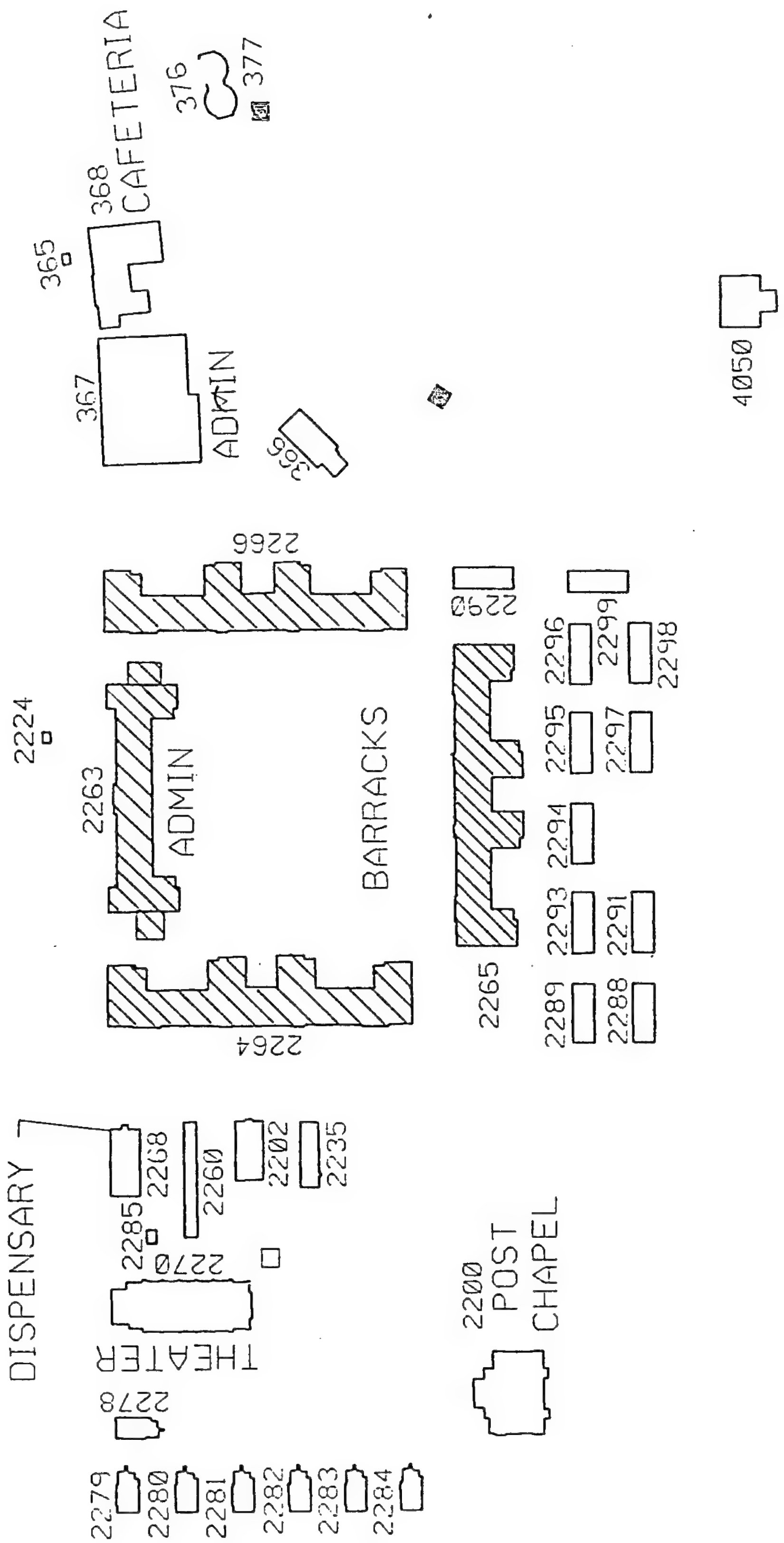
JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Trane #PCV-5F-C1D1 water cooled, centrifugal, 600 tons, R-11	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	564 KW	24	7	26	1,464,005	
Water Chiller	1	Trane #PCV-5F-C1D1 water cooled, centrifugal, 600 tons, R-11	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	564 KW	24	7	26	130,286	
Water Chiller	1	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Bldg. 1350	1983	329 KW	24	7	26	595,685	
Chilled Water Pump	2	Aurora 870 gpm, 79 ft 25 HP	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	18.65 KW	24	7	26	164,716	
Chilled Water Pump	1	Allis Chalmers 775 gpm, 114 ft 40 HP	Bldg. 1350	1983	29.84 KW	24	7	26	131,830	
Condenser Water Pump	2	Aurora 1440 gpm, 70 ft 40 HP	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	29.84 KW	24	7	26	171,908	
Condenser Water Pump	1	Allis Chalmers 1314 gpm, 30 ft 30 HP	Bldg. 1350	1983	22.38 KW	24	7	26	98,830	
Cooling Tower	1	Marley #324T induced draft, 2-35 HP fans	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	52.22 KW	24	7	26	210,896	
Cooling Tower	1	Marley induced draft, 20 HP fan	Bldg. 1350	1983	14.92 KW	24	7	26	60,215	
Hot Water Boiler	2	C.B. #CB700X-200 10 HP forced draft, 5912 MBH output	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	8,369 MBH 7.46 KW	24	7	26	32,406	15,611
Hot Water Boiler	1	Rite #A750WG natural draft, watertube 5317 MBH output	Bldg. 1350	1983	7,500 MBH	24	7	26		3,140
Hot Water Boiler	1	Ajax #WGB 9500 natural draft, watertube 4336 MBH output	Bldg. 1350	1983	5,800 MBH	24	7	26		0

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 1300

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Heating Water Pump	2	Aurora 443 gpm, 76 ft 15 HP	Bldgs. 1374, 1375, 1379, 1380, 1382, 1377, 1385	1972	11.19 KW	24	7	26	97,218	
Heating Water Pump	1	Allis Chalmers 134 ft 40 HP	Bldg. 1350	1983	29.84 KW	24	7	26	129,625	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365
376
377
367
ADMIN
4050
2266
2224
2263
ADMIN
BARRACKS
2290
2296
2299
2298
2295
2297
2294
2293
2291
2265
2289
2288
2264
DISPENSARY
2268
2260
2202
2235
2285
2270
THEATER
2200
POST
CHAPEL
2278
2279
2280
2281
2282
2283
2284

BUILDING DESCRIPTION

NAME: Building 2263

USE: Administrative offices for post fiscal activities. Maximum occupancy of 250 persons from 6:30 am until 5:15 pm on weekdays.

GROSS AREA (SQ.FT.): 81,065 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1970

STRUCTURE: Masonry

EXTERIOR WALLS: Stucco on CMU

ROOF: Pitched shingle roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Lay-in acoustical tile

WINDOWS: single and double pane clear glass in most of building and insulating glass in corridors.

COOLING EQUIP: Eight, single zone central air handlers serving the general office areas. Fourteen, four-pipe fan coil units serving corridors, stairwells and first floor office areas on the east and west ends. All units are served by the central chiller in building 2265.

HEATING EQUIP: See cooling equipment above. All units are served by the central boilers in building 2265.

LIGHTING: Recessed fluorescent fixtures and scattered incandescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: Packaged computer room units with outdoor fluid cooler serve the computer room in building. Some rooms in basement served by window units.

REMARKS: Poor temperature control. Extremely hot inside during field visit in mid March. Some inside areas were above 100 degrees F. All HVAC systems appeared to be in good condition with the exception of the temperature controls.

BUILDING DESCRIPTION

NAME: Buildings 2264, 2266

USE: Mainly barracks for single enlisted personnel, with administrative offices and classrooms. Also houses the Academy Museum and band area. Maximum occupancy of 255 persons per building on a continuous basis.

GROSS AREA (SQ.FT.): 98,190 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1970

STRUCTURE: Masonry

EXTERIOR WALLS: Plaster on stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Lay-in acoustical tile

WINDOWS: Single pane clear glass

COOLING EQUIP: Ten, four-pipe multi-zone air handlers serving all areas of the building. Average 3 to 6 zones per unit. All units are served by the central chiller in building 2265.

HEATING EQUIP: See cooling equipment above. All units are served by the central boilers in building 2265.

LIGHTING: Recessed fluorescent fixtures with incandescent fixtures scattered throughout building.

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

REMARKS: Poor temperature control. Extremely hot inside during field visit in mid March. All HVAC systems appeared to be in poor condition, especially the temperature controls.

BUILDING DESCRIPTION

NAME: Building 2265

USE: Mainly barracks for single enlisted personnel, with administrative offices and classrooms. Also houses the mess hall and central boiler and chiller plants. Maximum occupancy of 600 persons at meal time, with approximately 200 persons on a continuous basis.

GROSS AREA (SQ.FT.): 105,564 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1970

STRUCTURE: Masonry

EXTERIOR WALLS: Plaster on stone wall

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile and gypsum wallboard

WINDOWS: single pane clear glass

COOLING EQUIP: Ten, four-pipe multi-zone air handlers serving all areas of the building. Average 2 to 6 zones per unit. All units are served by the central chiller in building.

HEATING EQUIP: See cooling equipment above. All units are served by the central boilers in building behind.

LIGHTING: Recessed fluorescent fixtures with incandescent scattered in building.

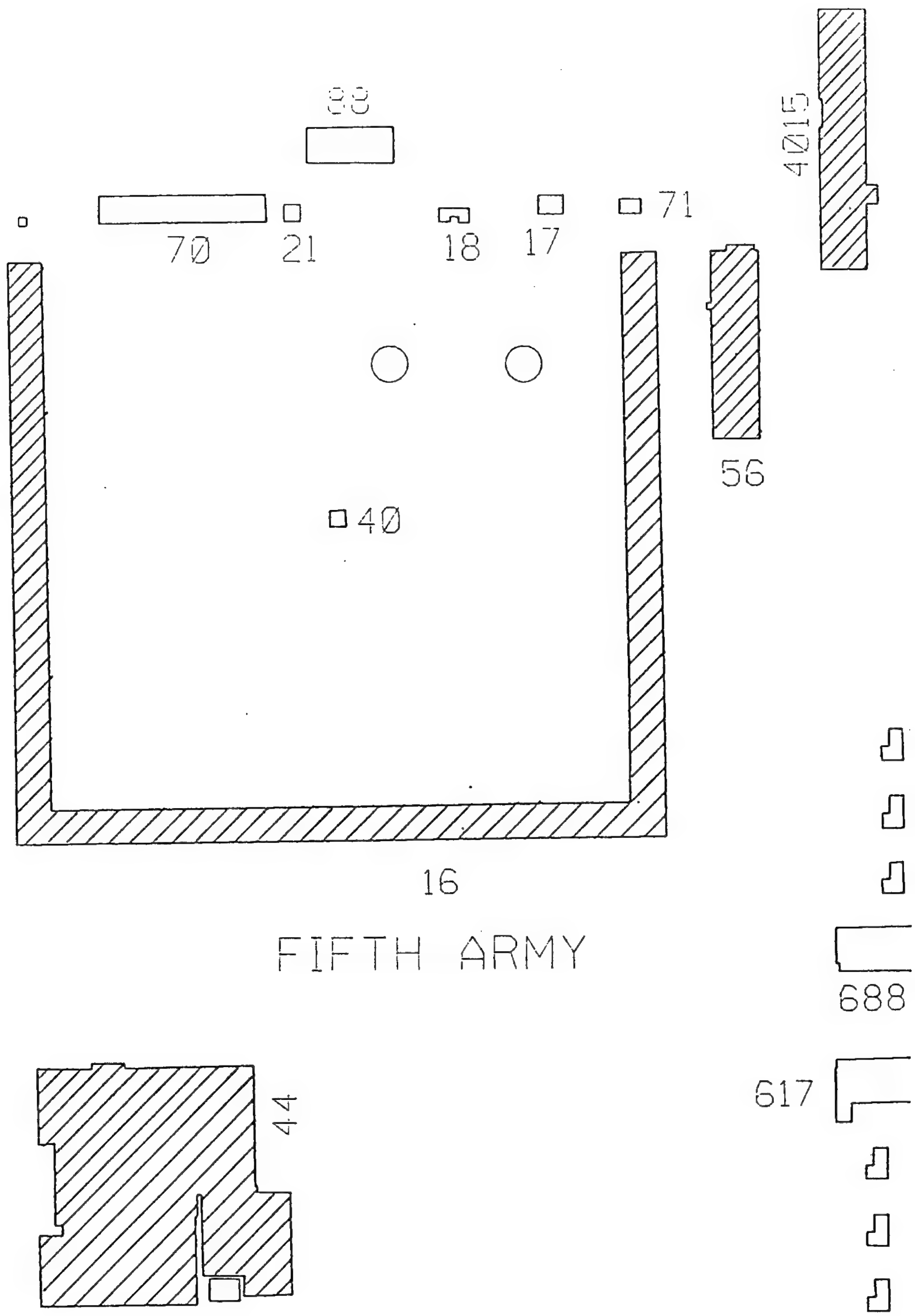
DOMESTIC WATER HEATING: Large gas fired boiler located in basement for domestic hot water heating in the building.

OTHER: Central chiller plant equipment in building and central boiler plant equipment in building behind. See HVAC Equipment Lists for descriptions. Steam boilers in basement serve kitchen equipment.

REMARKS: Poor temperature control. Extremely hot inside during field visit in mid March. All HVAC systems appeared to be in poor condition, especially the temperature controls. Boiler (heating water) plant appears in good condition, while chiller plant is aged.

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 2200
JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Chrysler #C2MN779-2 water cooled, centrifugal, 657 tons, R-11	Area 2200	1973	595 KW	24	7	26	994,146	
Chilled Water Pump	1	Paco 1526 gpm, 166 ft 100 HP	Area 2200	1973	74.60 KW	24	7	26	329,433	
Condenser Water Pump	1	Paco 1971 gpm, 63 ft 50 HP	Area 2200	1973	37.30 KW	24	7	26	164,717	
Cooling Tower	1	Built-up crossflow, 2 cell 2-20HP fans	Area 2200	1973	29.84 KW	24	7	26	121,471	
Hot Water Boiler	3	Ajax #WGB 4750 natural draft, watertube 2240 MBH output	Area 2200	1988	3,000 MBH	24	7	26		4,949
Heating Water Pump	3	Armstrong 207 gpm, 110 ft 15 HP	Area 2200	1988	11.19 KW	24	7	26	51,512	
Boiler Circulation Pump	3	Armstrong 3/4 HP	Hot Water Boiler	1988	0.56 KW	24	7	26	24	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4015
70
21
18
17
71
56
40
16
FIFTH ARMY
688
617
44

BUILDING DESCRIPTION

NAME: Building 4015

USE: Medical logistics training and offices, pharmaceutical storage. Maximum occupancy of 100 persons on weekdays, between 7:30 am and 4:30 pm.

GROSS AREA (SQ.FT.): 14,568 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1956

STRUCTURE: Frame

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: wood covered with linoleum

CEILINGS: suspended metal lathe

WINDOWS: single pane clear glass

COOLING EQUIP: Three multizone air handlers serving the classrooms, offices and storage areas. A 50 ton air cooled reciprocating chiller outside building serves the air handlers. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. A 800 MBH heating water boiler in building serving air handlers. See HVAC Equipment Lists for details.

LIGHTING: Suspended fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: 5 HP chilled water pump and 2 HP heating water pump serving chiller and boiler. See HVAC Equipment Lists for details.

REMARKS: All HVAC equipment, including controls, appeared to be in fair condition.

BUILDING DESCRIPTION

NAME: Building 56

USE: Administrative offices for post security and pentathlon, classroom areas for training and testing. Maximum occupancy of 65 persons during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 8,025 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1941

STRUCTURE: Frame

EXTERIOR WALLS: Siding and brick

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: One multi-zone air handler serving all conditioned areas of the building. Unit served by air cooled reciprocating chiller, approximately 30 tons nominal. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Steam to heating water generator served from boiler in building 16, furnishing heating water for multizone above. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: 1 HP chilled water pump, and 1/8 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control, very hot inside during the field visit. All HVAC equipment appeared to be in fair to poor condition with the exception of new chiller, however most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Building 16

USE: Headquarters for the 5th Army. Maximum 300 occupants during weekdays between 6:30 am and 6:00 pm.

GROSS AREA (SQ.FT.): 76,102 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Slab on grade

FLOOR FINISH: concrete and carpet

CEILINGS: acoustical tile

WINDOWS: single and double pane clear glass and insulating glass in corridor

COOLING EQUIP: Approximately five, single zone air handlers serving office areas on the first and second floor. Four fan coil units serving the second floor corridor. All units served by two air cooled chillers outside building, total 230 nominal tons capacity. See HVAC Equipment Lists for details. Also 24 packaged DX cooling units serve the wing areas. DX units served by three evaporative condensers outside building. Computer room units served by air cooled condenser and stand alone compressor in building mechanical room.

HEATING EQUIP: See cooling equipment above. Steam unit heaters serve the wings. All units served by two steam boilers inside building, total 5,800 MBH total output capacity. See HVAC Equipment Lists for details.

LIGHTING: lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: Two, 7.5 HP chilled water pumps serving chillers. See HVAC Equipment Lists for details. Condensate pumps scattered through building.

REMARKS: Poor temperature control, portions of building were comfortable while others were very hot during the field visit. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly

BUILDING DESCRIPTION

NAME: Building 44

USE: Administrative offices for the 5th Army. Maximum occupancy of 350 persons during weekdays between 7:30 am and 4:30 pm.

GROSS AREA (SQ.FT.): 95,332 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/9

DATE OF CONSTRUCTION: 1956

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and Stucco

ROOF: Flat built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Lay-in acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Two dual-duct air handlers serving 1st and 2nd floor offices. Single zone, VAV air handler serving 3rd floor offices. Five single zone air handlers serving 1st floor computer room, 1st floor addition and deli. Most units served by air cooled reciprocating chillers outside with total 255 nominal tons capacity. See HVAC Equipment Lists for details. 1st floor addition and deli unit are DX cooling.

HEATING EQUIP: See cooling equipment above. All units served by 13 steam boilers, total 3440 MBH output capacity. See HVAC Equipment Lists for details.

LIGHTING: Lay in fluorescent fixtures, recessed incandescent scattered in building.

DOMESTIC WATER HEATING: Gas fired hot water heaters in building to serve restrooms.

OTHER: 20 HP chilled water pump serving chillers. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control in building. Extremely hot, especially on the second floor where the lights are on 24 hours/day. Large air handlers and boilers in this building are aging and in appear in poor condition.

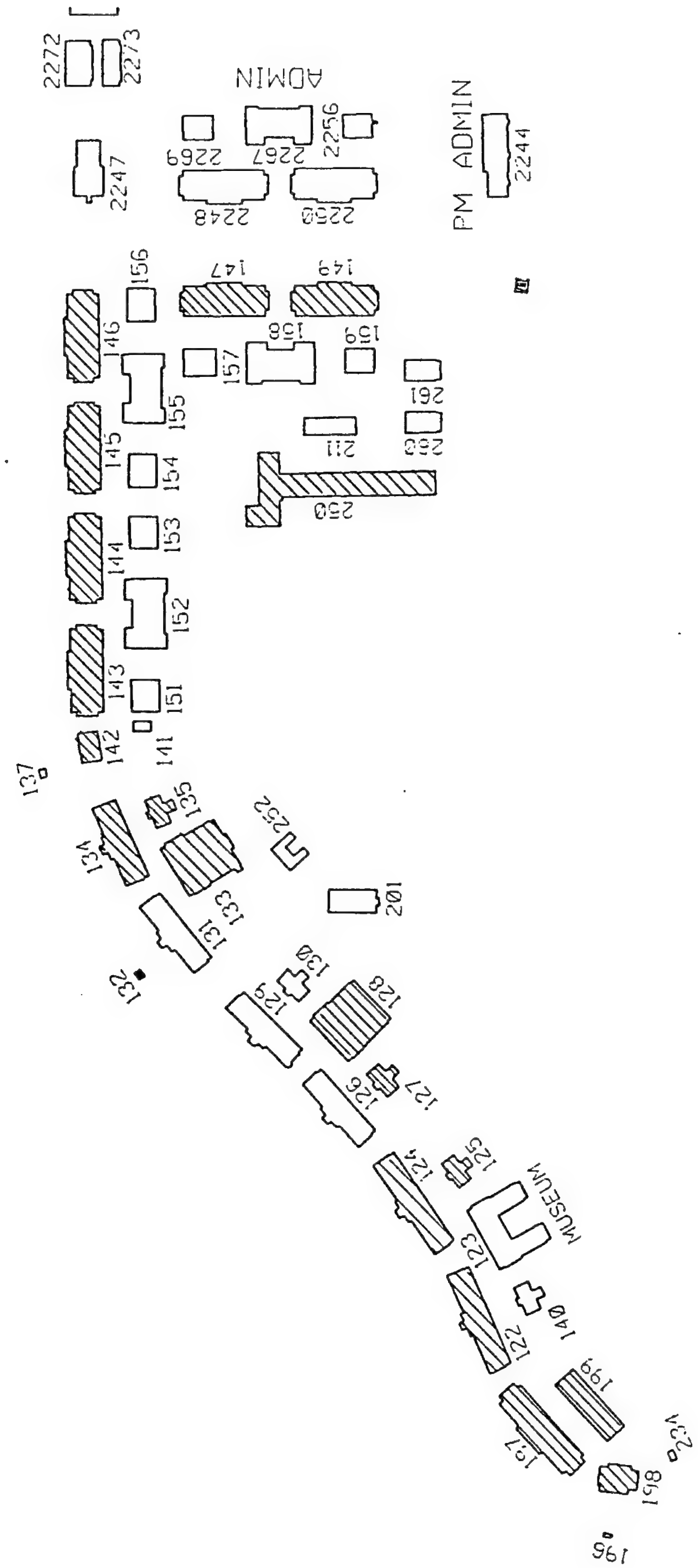
HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, QUADRANGLE AREA

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	TSI #CA2CD 75 air cooled, recip. 50 tons, R-22	Bldg. 4015	1983	88 KW	24	7	26	180,278	
Chilled Water Pump	1	Paco 5 HP	Bldg. 4015	1983	3.73 KW	24	7	26	16,472	
Hot Water Boiler	1	Rite #R8-C-05 forced draft, 5 HP blower 741 MBH output	Bldg. 4015	1987	1,000 MBH 3.73 KW	24	7	26	4,275	120
Heating Water Pump	1	N/A 3 HP	Bldg. 4015	1987	2.24 KW	24	7	26	1,821	
Water Chiller	1	Trane #CDAGC30GACA air cooled, recip. 30 tons	Bldg. 56	1993	49 KW	24	7	26	76,755	
Chilled Water Pump	2	Armstrong 207 gpm, 110 ft 5 HP	Bldg. 56	1993	3.73 KW	24	7	26	32,944	
Water Chiller	1	TSI #30AOCM 140 air cooled, recip. 120 tons	Bldg. 16	1994	194 KW	24	7	26	393,031	
Water Chiller	1	TSI #CA2CM 110 air cooled, recip. 110 tons	Bldg. 16	1987	190 KW	24	7	26	122,759	
Chilled Water Pump	2	Taco 350 gpm, 50 ft 7.5 HP	Bldg. 16	1987	5.60 KW	24	7	26	49,460	
Steam Boiler	1	Rite #2255 natural draft, watertube 1614 MBH output	Bldg. 16	1979	2,250 MBH	24	7	26		267
Steam Boiler	1	Rite #500 natural draft, watertube 3587 MBH output	Bldg. 16, Bldg 56	1979	5,000 MBH	24	7	26		651
Evaporative Condenser	1	Marley - 3 misc. models 2 - 3 HP & 5 HP pumps, 3 - 1/2 HP fans	Bldg. 16	1978	9.33 KW	24	7	26	41,201	

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, QUADRANGLE AREA
JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York #LCHA 65 17D air cooled, recip. 65 tons	Bldg. 44	1985	114 KW	24	7	26	296,194	
Water Chiller	2	York #LEHA 95 25D air cooled, recip. 95 tons	Bldg. 44	1985	167 KW	24	7	26	347,464	
Chilled Water Pump	1	N/A 20 HP	Bldg. 44	1985	14.92 KW	24	7	26	65,887	
Chilled Water Pump	2	Aurora 208 gpm, 421 ft 5 HP	Bldg. 44	1985	3.73 KW	24	7	26	10,858	
Steam Boiler	7	HydroTherm modular 264 MBH output	Bldg. 44	1970	385 MBH	24	7	26		103
Steam Boiler	5	HydroTherm modular 236 MBH output	Bldg. 44	1970	335 MBH	24	7	26		66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124
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MUSEUM
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234
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196

BUILDING DESCRIPTION

NAME: Buildings 122 & 124

USE: Administrative offices - Dir. of Resource Management. Continuous occupancy of approximately 30 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 12,782 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Three multi-zone air handling units serving all conditioned areas of the building. Units served by air cooled reciprocating chiller, approximately 40 tons nominal in bldg. 122 & 50 tons nominal in bldg. 124.. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 850 MBH heating water boiler in basement See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 3 HP chilled water pump, and 1-1/2 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control, very hot inside during the field visit. Building 124 was being renovated at the time of the site visit. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Buildings 125, 127, & 135

USE: Administrative offices - Community Operations Div., J. A. office, U.S.M.A. Admin. Field office. Continuous occupancy of approximately 5 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 1,593 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: Single pane clear glass

COOLING EQUIP: Building 125 is the only one of these buildings that has fan coils. The other two buildings have furnace units with evaporator coils. Bldgs. 125 and 135 are both served by air cooled chillers that also serve adjacent building 124 and 134. Building 127 is served by a 4.5 ton outdoor condensing unit. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water for bldg. 125 and 135 is provided by a 820 MBH boiler in the basement of buildings 124 and 134. the furnace in Bldg. 127 is served by gas. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building.

REMARKS: Poor temperature control, very hot inside during the field visit. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Building 128

USE: Boys & Girls Scouts Offices.

GROSS AREA (SQ.FT.): 14,224 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95 DATE OF CONSTRUCTION: 1940

STRUCTURE: Frame

EXTERIOR WALLS: Brick , stone, and siding

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Air handling units, fan coil units, and several window units serve all conditioned areas of the building. Units served by 40 ton nominal air cooled reciprocating chiller. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 150 MBH heating water boiler in basement See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building.

OTHER: 1-1/2 HP chilled water pump, and 1/2 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: This building was unavailable to be entered during site visit. Chiller appeared to be in fair condition.

BUILDING DESCRIPTION

NAME: Building 133

USE: Administrative offices - Medical/Pharmaceutical operations. Continuous occupancy of approximately 50 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 13,232 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and siding

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Multi-zone air handling units and fan coil units serving all conditioned areas of the building. Units served by 25 ton nominal air cooled reciprocating chiller. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 150 MBH heating water boiler in basement See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building.

OTHER: 1-1/2 HP chilled water pump, and 1/2 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: Temperature control in good condition. Comfortable inside during the field visit. All HVAC equipment appeared to be in fair condition.

BUILDING DESCRIPTION

NAME: Building 134

USE: Legal offices. Continuous occupancy of approximately 40 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 10,434 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and stone

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: Three multi-zone air handling units serving all conditioned areas of the building. Units served by 30 ton nominal air cooled reciprocating chiller which also serves bldg. 135. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 820 MBH heating water boiler in basement See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 1/2 HP chilled and heating water pumps. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control, very hot inside during the field visit especially on second floor near window covered vestibule. All HVAC equipment appeared to be in fair to poor condition, however most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Buildings 142

USE: Administrative offices - Reg. H.Q. and deferred maintenance.

GROSS AREA (SQ.FT.): 4,735 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1945

STRUCTURE: Masonry

EXTERIOR WALLS: Brick and CMU

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: Single pane clear glass

COOLING EQUIP: This building is served by a 10 ton nominal air cooled chiller. See HVAC Equipment Lists for details.

HEATING EQUIP: Heating water for this building is assumed to be provided by a 450 MBH boiler in the basement. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Electric hot water heater in building.

REMARKS: This building was unavailable to be entered during site visit. Chiller appeared to be in fair condition. This building has it's own electrical meter.

BUILDING DESCRIPTION

NAME: Buildings 143, 144, 145,146

USE: Administrative offices. Continuous occupancy of approximately 50 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 13,483 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry with frame add-on

EXTERIOR WALLS: Brick, stone and wood shingles

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass and tempered glass for enclosed porch

COOLING EQUIP: Bldgs. 143, 144, and 146 are served by multi-zone and single-zone air handling units, and bldg 143 contains packaged window units for cooling. The air handlers in bldg 143, 144, & 146 are served by 45, 45, & 40 ton nominal air cooled reciprocating chillers. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. The air handlers in bldgs. 143, 144, & 146 are served by an 850 MBH heating water boiler in the basements. Warm air furnace provides heating for bldg. 145. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 3 HP chilled water pump, and 1 HP heating water pump in bldgs. 143 & 144. 1-1/2 HP chilled water pump and 1 HP heating water pump for bldg. 146. Building 144 also has a 4 ton condensing unit that serves computer room. See HVAC Equipment Lists for details.

REMARKS: Building 143 was empty and awaiting renovation at the time of the site visit. Window units are in poor condition and thus create maintenance problems. All other HVAC equipment appeared to be in fair to poor condition and most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Buildings 147 & 149

USE: Billeting for Reserves, Family Residence. Continuous occupancy of approximately 50 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 11,522 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1939

STRUCTURE: Masonry

EXTERIOR WALLS: Brick

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Acoustical tile

WINDOWS: single pane clear glass

COOLING EQUIP: One multi-zone air handling unit serves each of these buildings. 50 ton air cooled reciprocating chiller serves both bldg. 147 & 149. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 850 MBH heating water boiler in each bldgs. basement. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures and scattered incandescent fixtures.

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 5 HP chilled water pump, and two 1 HP heating water pumps. See HVAC Equipment Lists for details.

REMARKS: All HVAC equipment appeared to be in fair to poor condition. Piping between buildings appears to be deteriorating.

BUILDING DESCRIPTION

NAME: Buildings 197

USE: Headquarter of Fifth Army Band, future 323rd Medical Battalion Supply. Continuous occupancy of approximately 35 people during weekdays, between approximately 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 13,819 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Frame

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile, Plaster

WINDOWS: Single pane clear glass

COOLING EQUIP: Three 4- Pipe, single-zone fan and coil units serve all conditioned areas of the building. Units served by air cooled reciprocating chiller, approximately 50 tons nominal. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 1750 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Lay-in and surface mounted fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 2 HP chilled water pump, and 1 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control, very hot inside during the field visit. Very old ductwork with dust mold and mildew. Control problems create moisture pockets on furniture and causes moisture problems with computers. All HVAC equipment appeared to be in poor condition, and most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Building 198

USE: Physical/Medical Evaluation Board. Continuous occupancy of approximately 20 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 5,468 STORIES: 2 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1945

STRUCTURE: Frame

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and tile

CEILINGS: Acoustical tile, Plaster

WINDOWS: single pane clear glass

COOLING EQUIP: Two single-zone fan and coil units serving all conditioned areas of the building. Units served by nominal 10 ton air cooled reciprocating chiller. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above and unit heater. Heating water is provided by 450 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Surface mounted incandescent fixtures and fluorescent fixtures

DOMESTIC WATER HEATING: Electric water heater in building.

OTHER: 1-1/2 HP chilled water pump, and 3/4 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control. Air-side equipment is maintenance intensive. All HVAC equipment appeared to be in poor condition.

BUILDING DESCRIPTION

NAME: Building 199

USE: Band Rehearsal Hall. Intermittent occupancy of approximately 60 people during weekdays, between 7:00 am and 5:00 pm.

GROSS AREA (SQ.FT.): 6,415 STORIES: 1 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION 1940

EXTERIOR WALLS: Stucco

ROOF: Pitched roof with shingles

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete and carpet

CEILINGS: Plaster

WINDOWS: single pane clear glass

COOLING EQUIP: One multi-zone air handling unit serves all conditioned areas of the building. Unit is served by nominal 15 ton air cooled reciprocating chiller. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. Heating water is provided by 200 MBH heating water boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Recessed and surface mounted fluorescent fixtures

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 2 HP chilled water pump, and 1-1/2 HP heating water pump. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control. Area is critical to humidity control because instruments are susceptible to humidity. All HVAC equipment appeared to be in fair condition, however most controls were not functioning properly.

BUILDING DESCRIPTION

NAME: Building 250

USE: NCO Academy, barracks, and future chef training school. Continuous occupancy of approximately 250 people between 5:00 pm and 7:00 a.m.

GROSS AREA (SQ.FT.): 42,955 STORIES: 3 DATE OF SURVEY: 3/13 to 3/17/95

DATE OF CONSTRUCTION: 1940

STRUCTURE: Masonry

EXTERIOR WALLS: Stucco

ROOF: Flat built-up roof

FLOOR CONSTRUCTION: Pier and beam

FLOOR FINISH: Concrete, tile and carpet

CEILINGS: Acoustical tile, gypsum wallboard, plaster

WINDOWS: single pane clear glass

COOLING EQUIP: Six multi-zone air handling units serve the barracks portion of building and one multi-zone air handling unit serves the future chef school. All units are served by a 100 ton nominal air cooled reciprocating chiller. See HVAC Equipment Lists for details.

HEATING EQUIP: See cooling equipment above. All heating coils in the air handlers are steam. Steam is provided by 1000 MBH steam boiler in basement. See HVAC Equipment Lists for details.

LIGHTING: Lay-in fluorescent fixtures in future chef school, admin, and barracks; surface mounted incandescent and fluorescent fixtures in barracks.

DOMESTIC WATER HEATING: Gas fired hot water heater in building.

OTHER: 7-1/2 HP chilled water pump. See HVAC Equipment Lists for details.

REMARKS: Poor temperature control, very hot inside during the field visit. The air cooled chiller appeared to be in good condition and all other HVAC equipment appeared to be in fair condition.

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Hot Water Boiler	1	Rite #HD-85 watertube 618 MBH output	Bldg. 122	1985	850 MBH	24	7	26		193
Heating Water Pump	2	B&G 32 gpm, 50 ft 1.5 HP	Bldg. 122	1985	1.12 KW	24	7	26	8,242	
Water Chiller	1	Trane #CGABC401AF01FK air cooled. recip. 40 tons	Bldg. 122	1985	70 KW	24	7	26	92,395	
Chilled Water Pump	2	N/A 3 HP	Bldg. 122	1985	2.24 KW	24	7	26	19,784	
Hot Water Boiler	1	Ajax natural draft, watertube 618 MBH output	Bldgs. 124, 125	1985	850 MBH	24	7	26		226
Heating Water Pumps	2	Amtrol 23 GPM, 50 ft 1.5 HP	Bldgs. 124, 125	1985	1.12 KW	24	7	26	9,730	
Water Chiller	1	TSI #30-AOCD65 air cooled, recip. 50 tons	Bldgs. 124, 125	1985	88 KW	24	7	26	112,912	
Chilled Water Pumps	2	Mueller 53 gpm, 71 ft 3 HP	Bldgs. 124, 125	1985	2.24 KW	24	7	26	19,784	
Split System Furnace	1	RUUD 33 MBH output	Bldg 127	1985	45 MBH	24	7	26	3,154	36
Condensing Unit	1	RUUD #UACC-056JAS 4.5 ton, 7 EER	Bldg 127	1985	8.48 KW	24	7	26	13,240	
Hot Water Boiler	1	N/A 109 MBH output	Bldg. 128	1985	150 MBH	24	7	26		82
Heating Water Pump	1	N/A 1/2 HP	Bldg. 128	1985	0.37 KW	24	7	26	1,607	

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100
JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Trane #CGABC403AE00F air cooled, recip. 40 tons	Bldg. 128	1985	70 KW	24	7	26	12,045	
Chilled Water Pump	1	N/A 1.5 HP	Bldg. 128	1985	1.12 KW	24	7	26	4,946	
Hot Water Boiler	1	Ajax #WGHD-150 forced draft, 5 HP blower 109 MBH output	Bldg. 133	1985	150 MBH 3.73 KW	24	7	26	16,203	177
Heating Water Pump	1	N/A 1/2 HP	Bldg. 133	1985	0.37 KW	24	7	26	1,607	
Water Chiller	1	Trane #CGABC256AF01FK air cooled, recip. 25 tons	Bldg. 133	1985	44 KW	24	7	26	76,773	
Chilled Water Pump	1	Aurora 40 gpm, 70 ft 1.5 HP	Bldg. 133	1985	1.12 KW	24	7	26	4,946	
Hot Water Boiler	1	Thermopak #GWE 825 watertube 596 MBH output	Bldgs 134, 135	1985	820 MBH	24	7	26		116
Heating Water Pump	1	Armstrong, close coupled 1/2 HP	Bldgs 134, 135	1985	0.37 KW	24	7	26	2,136	
Water Chiller	1	Trane #CGACC306KANDD air cooled, recip. 30 tons	Bldgs 134, 135	1985	53 KW	24	7	26	104,024	
Chilled Water Pump	1	Armstrong, close coupled 63 ft, 1/2 HP	Bldgs 134, 135	1985	0.37 KW	24	7	26	1,634	
Hot Water Boiler	1	N/A 327 MBH output	Bldg. 142	1985	450 MBH	24	7	26		58
Heating Water Pump	1	N/A 1/2 HP	Bldg. 142	1985	0.37 KW	24	7	26	1,008	

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100
JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Carrier #30GT-020-500 air cooler, recip. 10 tons	Bldg. 142	1985	18 KW	24	7	26	26,626	
Chilled Water Pump	1	N/A 1 HP	Bldg. 142	1985	0.75 KW	24	7	26	3,312	
Water Chiller	1	N/A air cooled, recip. 45 tons	Bldg. 143	1985	79 KW	24	7	26	113,775	
Chilled Water Pump	1	N/A 3 HP	Bldg. 143	1985	2.24 KW	24	7	26	9,892	
Hot Water Boiler	1	N/A 596 MBH output	Bldg. 143	1985	820 MBH	24	7	26		76
Heating Water Pump	1	N/A 1/2 HP	Bldg. 143	1985	0.37 KW	24	7	26	1,039	
Water Chiller	1	TSI #CAZCD 45 air cooled, recip. 45 tons	Bldg. 144	1985	79 KW	24	7	26	113,775	
Chilled Water Pump	1	Aurora 58 gpm, 86 ft 3 HP	Bldg. 144	1985	2.24 KW	24	7	26	9,892	
Hot Water Boiler	1	Bryan 596 MBH output	Bldg. 144	1985	820 MBH	24	7	26		112
Heating Water Pump	1	B&G 1 HP	Bldg. 144	1985	0.75 KW	24	7	26	1,904	
Terminal Cooling Unit	1	Data Temp #DTA-0532-01 Russell #TD6.5 condenser 4 ton, 9 EER	Bldg. 144	1985	5.81 KW	24	7	26	0	
Window A/C Units	23	Fredrich #MDD YL 24H3513 2 ton clg, 22.4 MBH htg. 9 EER	Bldg. 145	1985	2.67 KW	24	7	52	71,349	

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Hot Water Boiler	1	Teledyne Laars 596 MBH	Bldg. 146	1985	820 MBH	24	7	52		112
Heating Water Pump	1	N/A 1 HP	Bldg. 146	1985	0.75 KW	24	7	52	1,904	
Water Chiller	1	Trane #CGABC404AF00F air cooled, recip. 40 tons	Bldg. 146	1985	70 KW	24	7	52	107,387	
Chilled Water Pump	1	Taco 83 gpm, 1.5 HP	Bldg. 146	1985	1.12 KW	24	7	52	4,946	
Hot Water Boiler	1	Ajax #WG-750-5 596 MBH output	Bldg. 147	1985	820 MBH	24	7	52		112
Heating Water Pump	1	Taco 1 HP	Bldg. 147	1985	0.75 KW	24	7	52	1,904	
Water Chiller	1	McQuay #ALR 040AD air cooled, recip. 50 tons	Bldgs 147, 149	1985	88 KW	24	7	26	170,355	
Chilled Water Pump	1	Paco 5 HP	Bldgs 147, 149	1985	3.73 KW	24	7	26	16,472	
Hot Water Boiler	1	Thermopak #GWE 825 596 MBH output	Bldg. 149	1985	820 MBH	24	7	26		116
Heating Water Pump	1	Paco 40 gpm, 40 ft 1 HP	Bldg. 149	1985	0.75 KW	24	7	26	2,136	
Hot Water Boiler	1	Ajax #WG-1750 1400 MBH output	Bldg. 197	1985	1,750 MBH	24	7	26		89
Heating Water Pump	1	B&G 1 HP	Bldg. 197	1985	0.75 KW	24	7	26	1,257	

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York #LCHA 50-17A air cooled, recip. 50 tons	Bldg. 197	1985	88 KW	24	7	26	113,383	
Chilled Water Pump	1	Peerless 2 HP	Bldg. 197	1985	1.49 KW	24	7	26	6,580	
Hot Water Boiler	1	National #209-7 natural draft 327 MBH output	Bldg. 198	1985	450 MBH	24	7	26		38
Heating Water Pump	1	Taco 3/4 HP	Bldg. 198	1985	0.56 KW	24	7	26	1,106	
Water Chiller	1	Trane #MAUG-C156-B air cooled. recip. 10 tons	Bldg. 198	1985	18 KW	24	7	26	30,616	
Chilled Water Pump	1	N/A 1.5 HP	Bldg. 198	1985	1.12 KW	24	7	26	4,946	
Hot Water Boiler	1	Ajax #WG-200-S natural draft 145 MBH output	Bldg. 199	1985	200 MBH	24	7	26		99
Heating Water Pump	1	N/A 1.5 HP	Bldg. 199	1985	1.12 KW	24	7	26	4,865	
Water Chiller	1	RUUD #RAWC 150 CAS air cooled. recip. 15 tons	Bldg. 199	1985	26 KW	24	7	26	43,319	
Chilled Water Pump	1	N/A 2 HP	Bldg. 199	1985	1.49 KW	24	7	26	6,580	
Steam Boiler	2	Kewanee #581, series 3X 800 MBH output	Bldg. 250	1985	1,000 MBH	24	7	26		172
				1985						

HVAC EQUIPMENT LIST FOR: FORT SAM HOUSTON, AREA 100

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Trane #CGACD111 air cooled, recip. 100 tons	Bldg. 250	1985	160 KW	24	7	26	346,860	
Chilled Water Pump	1	Paco 7.5 HP	Bldg. 250	1985	5.60 KW	24	7	26	24,730	

APPENDIX D

RECOMMENDED ECO CALCULATIONS

APPENDIX D
RECOMMENDED ECO CALCULATIONS

TABLE OF CONTENTS

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	A
DATE:	6/15/95
ECO TITLE:	Replace Existing Central Chiller With New Electric Screw Chiller
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 900, Building 902

A. Summary:

Electrical Energy Savings	434	MMBTU/yr
Electrical Demand Savings	2,520	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	434	MMBTU/yr
Total Cost Savings	17,650	\$/yr
Total Investment	157,256	\$
Simple Payback	8.9	yrs
SIR	2.08	

B. ECO Description:

Remove the existing 300 ton, R-11 centrifugal chiller in building 902 and replace it with a 300 ton, R-134a screw chiller. The existing 25 HP chilled water (CHW) pump, 15 HP condenser water (CND) pump and 15 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

C. Discussion:

The existing water cooled, centrifugal chiller was installed in 1985 and serves as the primary cooling system for the 21 buildings in the 900 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996[1]. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates[2]. However, since the machine is already ten years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that a dual screw chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 300 tons is required to adequately cool the buildings[3]. Therefore, no increase or decrease in the current chiller capacity is recommended at this time.

D. Savings Calculations:

1. *Energy Consumption And Savings*

The monthly peak demand and energy consumptions of the existing and proposed alternative chillers and auxiliary equipment were calculated using the Trace 600 computer program[4]. The buildings served by the existing chiller were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[5].

The 300 ton chiller alternatives which were compared included an electric centrifugal machine, an electric centrifugal with a variable frequency drive, a dual screw machine and a gas driven centrifugal machine. All proposed machines used R-134a. Full and part load performance data from York International were used in the computer simulations of the new chiller energy usages[6]. Equipment lists of the specific chillers and auxiliaries for each alternative modeled by the computer are shown on pages D-4 to D-7.

Once the computer simulations were completed, the total annual demand cost and energy consumption of each alternative were compared with that of the existing systems to determine the annual savings for each[7]. These savings calculations are shown on pages D-8 and D-9. The demand and energy savings values were used in the life cycle cost analysis for each alternative. The results of these savings calculations were as follows:

Alternative	**Chiller Type**	**Demand Savings $/yr**	**Electrical Savings MMBTU/yr**	**Gas Savings MMBTU/yr**
A1	Electric Centrifugal	2,870	253	0
A2	Electric Centrifugal & VFD	3,167	529	0
A3	Electric Screw	2,520	434	0
A4	Gas Driven Centrifugal	10,987	1,516	-3,386

2. *Maintenance Cost Savings*:

By installing a new chiller in place of the existing one, the installation will save the cost of retrofitting the machine for the HCFC-123 refrigerant as mentioned previously. The cost of this retrofit was estimated to be $248,085 on page D-10. This value was used in the life cycle cost analysis as a non-recurring savings for each alternative.

E. Cost Estimates

The total installation costs for each alternative chiller mentioned in this ECO were estimated on pages D-11 through D-14. These costs were used in the life cycle cost analysis for each alternative. The results of the costs estimates were as follows:

Alternative	Chiller Type	Estimated Cost
A1	Electric Centrifugal	$153,242
A2	Electric Centrifugal & VFD	$193,215
A3	Electric Screw	$157,256
A4	Gas Driven Centrifugal	$349,928

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on each chiller alternative for this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for each life cycle cost analysis is shown on pages D-15 through D-18. The results of the alternative life cycle cost analysis were as follows:

Alternative	Chiller Type	Payback Years	SIR
A1	Electric Centrifugal	9.1	2.05
A2	Electric Centrifugal & VFD	10.2	1.97
A3	Electric Screw	8.9	2.08
A4	Gas Driven Centrifugal	14.6	1.11

Since the electric screw chiller has the highest SIR, it is recommended as the most economical choice to replace the existing machine. The data from the life cycle cost analysis for this alternative were included in the summary on page D-1.

REFERENCES

1. Per current EPA regulations on CFC refrigerants.
2. See Appendix G for chiller retrofit estimates from Northeastern Research And Engineering Corporation.
3. See Appendix B for Area 900 cooling system load profile.
4. See Appendix B for computer model input assumptions and data, and energy consumption output data.
5. See Appendix C for building field data and existing HVAC system data.
6. See Appendix G for manufacturer's equipment performance data from York International.
7. See Appendix A for utility cost analysis data, used in the savings calculations.

PROPOSED HVAC EQUIPMENT LIST FOR: EC0-A1, FORT SAM HOUSTON, AREA 900

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York, electric water cooled, centrifugal, 300 Tons, R-134a	Area 900	New	177 KW	24	7	26	370,072	
Chilled Water Pump	1	Weinman 720 gpm, 100 ft 25 HP	Area 900	Exist	18.65 KW	24	7	26	82,358	
Condenser Water Pump	1	Weinman 912 gpm, 50 ft 15 HP	Area 900	Exist	11.19 KW	24	7	26	49,415	
Cooling Tower	1	Marley #MC8608 one cell 15 HP fan	Area 900	Exist	11.19 KW	24	7	26	45,441	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-A2, FORT SAM HOUSTON, AREA 900

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York, electric, VFD water cooled, centrifugal, 300 Tons, R-134a,	Area 900	New	177 KW	24	7	26	289,309	
Chilled Water Pump	1	Weinman 720 gpm, 100 ft 25 HP	Area 900	Exist	18.65 KW	24	7	26	82,358	
Condenser Water Pump	1	Weinman 912 gpm, 50 ft 15 HP	Area 900	Exist	11.19 KW	24	7	26	49,415	
Cooling Tower	1	Marley #MC8608 one cell 15 HP fan	Area 900	Exist	11.19 KW	24	7	26	45,401	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-A3, FORT SAM HOUSTON, AREA 900

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York, electric water cooled, dual screw 300 Tons, R-134a	Area 900	New	186 KW	24	7	26	317,039	
Chilled Water Pump	1	Weinman 720 gpm, 100 ft 25 HP	Area 900	Exist	18.65 KW	24	7	26	82,358	
Condenser Water Pump	1	Weinman 912 gpm, 50 ft 15 HP	Area 900	Exist	11.19 KW	24	7	26	49,415	
Cooling Tower	1	Marley #MC8608 one cell 15 HP fan	Area 900	Exist	11.19 KW	24	7	26	45,444	

PROPOSED HVAC EQUIPMENT LIST FOR: EC0-A4, FORT SAM HOUSTON, AREA 900

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York, gas fired water cooled, centrifugal 300 Tons, R-134a	Area 900	New	1,980 MBH	24	7	26		3,386
Chilled Water Pump	1	Weinman 720 gpm, 100 ft 25 HP	Area 900	Exist	18.65 KW	24	7	26	82,358	
Condenser Water Pump	1	Weinman 912 gpm, 50 ft 15 HP	Area 900	Exist	11.19 KW	24	7	26	49,415	
Cooling Tower	1	Marley #MC8608 one cell 15 HP fan	Area 900	Exist	11.19 KW	24	7	26	45,352	

900 AREA

ITEM	EXISTING CENTRAL CHILLER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					202.4	202.7	223.5	225.8	208.0	115.8			444,056	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,510	
Totals					243.4	243.7	264.5	266.8	249.0	156.8			621,339	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					1,826	2,437	2,645	2,668	2,490	1,176				

Total Demand 13,242 $/yr
Total Energy 2,121 MMBTU/yr (electric)
Total Energy MMBTU/yr (gas)

ITEM	ECO-A1: NEW ELECTRIC CENTRIFUGAL CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					155.7	143.0	168.4	175.9	147.1	80.7			370,072	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,441	
Total (KW)					196.7	184.0	209.4	216.9	188.1	121.7			547,286	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					1,475	1,840	2,094	2,169	1,881	913				

Total Demand 10,372 $/yr
Demand Savings 2,870 $/yr
Energy Savings 253 MMBTU/yr (electric)
Energy Savings MMBTU/yr (gas)

ITEM	ECO-A2: NEW ELECTRIC CENTRIFUGAL CHILLER WITH VFD MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					144.1	138.0	166.7	175.3	141.8	69.5			289,309	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,401	
Total (KW)					185.1	179.0	207.7	216.3	182.8	110.5			466,483	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					1,388	1,790	2,077	2,163	1,828	829				

Total Demand 10,075 $/yr
Demand Savings 3,167 $/yr
Energy Savings 529 MMBTU/yr (electric)
Energy Savings MMBTU/yr (gas)

ITEM	ECO-A3: NEW ELECTRIC SCREW CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					163.7	150.3	176.9	184.9	154.6	76.2			317,039	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,444	
Total (KW)					204.7	191.3	217.9	225.9	195.6	117.2			494,256	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					1,535	1,913	2,179	2,259	1,956	879				

Total Demand	10,721	$/yr	
Demand Savings	2,520	$/yr	
Energy Savings	434	MMBTU/yr	(electric)
Energy Savings		MMBTU/yr	(gas)

ITEM	ECO-A4: NEW GAS ENGINE CENTRIFUGAL CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller														3,386
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					11.2	11.2	11.2	11.2	11.2	11.2			49,415	
Cooling Tower					11.2	11.2	11.2	11.2	11.2	11.2			45,352	
Total (KW)					41.0	41.0	41.0	41.0	41.0	41.0			177,125	3,386
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					308	410	410	410	410	308				

Total Demand	2,255	$/yr	
Demand Savings	10,987	$/yr	
Energy Savings	1,516	MMBTU/yr	(electric)
Energy Savings	-3,386	MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 900, BUILDING 902, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** CAP

PROJECT DESCRIPTION: ECO-A - Upgrade Existing R-11 Chiller To Operate With R-123

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Retrofit of existing R-11 chiller to use R-123	1	ea	80.00	$28.00	$2,240	$175,000	$175,000	$177,240
R-123 detection system	1	ea				$5,000	$5,000	$5,000
Chiller 2-speed ventilation fan	1	ea	16.00	$25.00	$400	$1,185	$1,185	$1,585
Chiller ventilation louver	10	sqft	4.00	$28.00	$1,120	$27	$270	$1,390
Test & balance	1	ea	4.00	$50.00	$200			$200
				SUBTOTAL	$3,960		$181,455	$185,415
			O & P @ 20%		$792		$36,291	$37,083
				SUBTOTAL	$4,752		$217,746	$222,498
			DESIGN @ 6%					$13,350
				SUBTOTAL				$235,848
			SIOH @ 5.5%					$12,237
				TOTAL				$248,085

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922
(817) 335-3000 * FAX (817) 335-1025

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 900 , BUIDING 902, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-A1, Replace Existing Central Chiller With New Centrifugal Chiller

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	40	$24.64	$986	$500	$500	$1,486
Install New Chiller 300 ton, water cooled, centrifugal, R-134a	1	EA	933	$24.64	$22,989	$78,000	$78,000	$100,989
Pipe Assembly And Valves	1	EA	42	$24.64	$1,035	$3,300	$3,300	$4,335
RECONNECT:								
Controls	1	JOB	45	$24.64	$1,109	$100	$100	$1,209
Electrical	1	JOB	22	$24.64	$542	$200	$200	$742
Refrigerant Detection System And Ventilation	1	JOB	41	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	20	$28.00	$560	$200	$200	$760
				SUBTOTAL	$28,231		$86,300	$114,531
				O & P @ 20%	$5,646		$17,260	$22,906
				SUBTOTAL	$33,877		$103,560	$137,437
				DESIGN @ 6%				$8,246
				SUBTOTAL				$145,683
				SIOH @ 5.5%				$7,559
				TOTAL				$153,242

HUITT-ZOLLARS, INC.

ENGINEERS / ARCHITECTS

512 MAIN STREET, SUITE 1500

FORT WORTH, TEXAS 76102-3922

(817) 335-3000 * FAX (817) 335-1025

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 900 , BUIDING 902, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-A2, Replace Existing Central Chiller With New Centrifugal Chiller And Variable Frequency Drive (VFD)

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	40	$24.64	$986	$500	$500	$1,486
Install New Chiller 300 ton, water cooled, centrifugal, R-134a	1	EA	933	$24.64	$22,989	$78,000	$78,000	$100,989
Adder For VFD	1	LS				$29,875	$29,875	$29,875
Pipe Assembly And Valves	1	EA	42	$24.64	$1,035	$3,300	$3,300	$4,335
RECONNECT:								
Controls	1	JOB	45	$24.64	$1,109	$100	$100	$1,209
Electrical	1	JOB	22	$24.64	$542	$200	$200	$742
Refrigerant Detection System And Ventilation	1	JOB	41	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	20	$28.00	$560	$200	$200	$760
				SUBTOTAL	$28,231		$116,175	$144,406
				O & P @ 20%	$5,646		$23,235	$28,881
				SUBTOTAL	$33,877		$139,410	$173,287
				DESIGN @ 6%				$10,397
				SUBTOTAL				$183,684
				SIOH @ 5.5%				$9,531
				TOTAL				$193,215

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922
(817) 335-3000 * FAX (817) 335-1025

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 900 , BUILDING 902, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-A3, Replace Existing Central Chiller With New Water Cooled Dual Screw Chiller

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	40	$24.64	$986	$500	$500	$1,486
Install New Chiller 300 ton, water cooled, dual screw, R-134a	1	EA	933	$24.64	$22,989	$81,000	$81,000	$103,989
Pipe Assembly And Valves	1	EA	42	$24.64	$1,035	$3,300	$3,300	$4,335
RECONNECT:								
Controls	1	JOB	45	$24.64	$1,109	$100	$100	$1,209
Electrical	1	JOB	22	$24.64	$542	$200	$200	$742
Refrigerant Detection System And Ventilation	1	JOB	41	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	20	$28.00	$560	$200	$200	$760
				SUBTOTAL	$28,231		$89,300	$117,531
				O & P @ 20%	$5,646		$17,860	$23,506
				SUBTOTAL	$33,877		$107,160	$141,037
				DESIGN @ 6%				$8,462
				SUBTOTAL				$149,499
				SIOH @ 5.5%				$7,757
				TOTAL				$157,256

HUITT-ZOLLARS, INC.
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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 900 , BUILDING 902, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-A4, Replace Existing Central Chiller With New Gas Engine Driven Chiller

ITEM DESCRIPTION	QUANTITY # of Units	QUANTITY Unit Meas.	LABOR Hrs / Unit	LABOR Rate	LABOR Total	MATERIAL Unit Price	MATERIAL Total	TOTAL COST
Remove chiller	1	EA	40	$24.64	$986	$500	$500	$1,486
Install New Chiller 300 ton, water cooled centrifugal, R-134a	1	EA	933	$24.64	$22,989	$225,000	$225,000	$247,989
Pipe Assembly And Valves	1	EA	42	$24.64	$1,035	$3,300	$3,300	$4,335
RECONNECT:								
Controls	1	JOB	45	$24.64	$1,109	$100	$100	$1,209
Electrical	1	JOB	22	$24.64	$542	$200	$200	$742
Refrigerant Detection System And Ventilation	1	JOB	41	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	20	$28.00	$560	$200	$200	$760
				SUBTOTAL	$28,231		$233,300	$261,531
				O & P @ 20%	$5,646		$46,660	$52,306
				SUBTOTAL	$33,877		$279,960	$313,837
				DESIGN @ 6%				$18,830
				SUBTOTAL				$332,667
				SIOH @ 5.5%				$17,261
				TOTAL				$349,928

HUITT-ZOLLARS, INC.
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LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: FSH

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)

INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY

FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A1

ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 137437.		
B. SIOH	$ 7559.		
C. DESIGN COST	$ 8246.		
D. TOTAL COST (1A+1B+1C)	$ 153242.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 153242.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	253.	$ 1589.	15.08	$ 23960.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 2870.	14.88	$ 42706.
N. TOTAL		253.	$ 4459.		$ 66665.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 248085.	0	1.00	248085.
d. TOTAL	$ 248085.			248085.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 248085.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 16863.

5. SIMPLE PAYBACK PERIOD (1G/4) 9.09 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 314750.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.05
(IF < 1 PROJECT DOES NOT QUALIFY)

** Project does not qualify for ECIP funding; 4,5,6 for information only.

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: FSH

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)

INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY

FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A2

ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 173287.		
B. SIOH	$ 9531.		
C. DESIGN COST	$ 10397.		
D. TOTAL COST (1A+1B+1C)	$ 193215.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 193215.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	529.	$ 3322.	15.08	$ 50098.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 3167.	14.88	$ 47125.
N. TOTAL		529.	$ 6489.		$ 97223.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 248085.	0	1.00	248085.
d. TOTAL	$ 248085.			248085.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 248085.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 18893.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.23 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 345308.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.79

(IF < 1 PROJECT DOES NOT QUALIFY)

*** Project does not qualify for ECIP funding; 4,5,6 for information only.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A3
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 141037.		
B. SIOH	$ 7757.		
C. DESIGN COST	$ 8462.		
D. TOTAL COST (1A+1B+1C)	$ 157256.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 157256.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	434.	$ 2726.	15.08	$ 41101.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 2520.	14.88	$ 37498.
N. TOTAL		434.	$ 5246.		$ 78598.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 248085.	0	1.00	248085.
d. TOTAL	$ 248085.			248085.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 248085.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 17650.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.91 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 326683.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.08
(IF < 1 PROJECT DOES NOT QUALIFY)

*** Project does not qualify for ECIP funding; 4,5,6 for information only.

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-A4
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 313837.	
B. SIOH	$ 17261.	
C. DESIGN COST	$ 18830.	
D. TOTAL COST (1A+1B+1C)	$ 349928.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 349928.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	1516.	$ 9520.	15.08	$ 143569.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	-3386.	$ -9007.	18.58	$ -167346.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 10987.	14.88	$ 163487.
N. TOTAL		-1870.	$ 11501.		$ 139710.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 248085.	0	1.00	248085.
d. TOTAL	$ 248085.			248085.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 248085.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 23905.

5. SIMPLE PAYBACK PERIOD (1G/4) 14.64 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 387795.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.11
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	C
DATE:	8/13/95
ECO TITLE:	Replace Existing Central Chillers With New Electric Centrifugal Chiller
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 1300, Building 1377

A. Summary:

Electrical Energy Savings	3,424	MMBTU/yr
Electrical Demand Savings	13,914	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	3,424	MMBTU/yr
Total Cost Savings	56,936	\$/yr
Total Investment	479,191	\$
Simple Payback	8.4	yrs
SIR	1.98	

B. ECO Description:

Remove the two 600 ton, R-11 centrifugal chillers in building 1377 which were installed in 1972, and replace them with one R-134 centrifugal chiller, rated at 827 tons. The two existing chilled water pumps and condenser water pumps serving the existing chillers should be removed. Install a new chilled water pump and a new condenser water pump, each rated at 75 HP, to serve the new chiller. The new chiller should be connected into the distribution piping at the existing location. New chilled water supply and return headers should be installed to join together the existing distribution systems serving building 1350 and the other seven buildings in the 1300 area. This will create a single chilled water distribution system to be served by the new chiller and the existing 438 ton chiller which was installed in 1983 to serve building 1350. All existing controls and electrical services should be reconnected where possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and pumps, and installation of the new chillers, pumps, associated wiring and controls.

C. Discussion:

There are currently two independent chilled water distribution systems serving the 1300 area, one for building 1350 and the other for seven other buildings. These two systems should be combined into one system to conserve energy in the central plant. This can be accomplished by installing common CHW supply and return headers in the central plant. The existing centrifugal chiller serving building 1350 was installed in 1983, is rated at 438 tons and appears to be in good condition. The two existing centrifugal chillers serving the other seven buildings were installed in 1972, are rated at 600 tons each, and appear to be near the end of their useful life. Also, all three chillers use the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996[1]. To avoid the anticipated increasing operational costs over the life of these machines, they should either be retrofitted to use an approved refrigerant or replaced with new machines that operate on one. The existing centrifugal machines can be retrofitted with no loss of capacity by replacing the impellers with new ones designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates[2]. However, since the older machines are already over twenty years old, it is recommended that the facility replace them instead. A life cycle cost analysis performed on four different types of

replacement chillers available determined that a single electric centrifugal chiller using R-134 would be the most economical choice over the life of the machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 1,638 tons is more than what is required to adequately cool the buildings[3]. Therefore, the new combined capacity is recommended to be 1,265 tons to more nearly match the building cooling load.

D. Savings Calculations:

1. *Energy Consumption And Savings*

The monthly peak demand and energy consumptions of the existing and proposed alternative chillers and auxiliary equipment were calculated using the Trace 600 computer program[4]. The buildings served by the existing chillers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[5].

The 827 ton chiller alternatives which were compared included an electric centrifugal machine, an electric centrifugal with a variable frequency drive, a dual screw machine and a gas driven centrifugal machine. All proposed machines used R-134. Full load performance data from York International were used in the computer simulations of the new chiller energy usages[6]. Equipment lists of the specific chillers and auxiliaries for each alternative modeled by the computer are shown on pages E-22 to E-25.

Once the computer simulations were completed, the total annual demand cost and energy consumption of each alternative were compared with that of the existing systems to determine the annual savings for each[7]. These savings calculations are shown on pages E-26 through E-28. The demand and energy savings values were used in the life cycle cost analysis for each alternative. The results of these savings calculations were as follows:

Alternative	Chiller Type	Demand Savings $/yr	Electrical Savings MMBTU/yr	Gas Savings MMBTU/yr
C1	Electric Centrifugal	13,914	3,424	0
C2	Electric Centrifugal & VFD	14,532	3,615	0
C3	Electric Screw	11,345	3,250	0
C4	Gas Driven Centrifugal	38,536	6,386	-8,886

2. *Maintenance Cost Savings*:

By installing a new chiller in place of the two oldest existing ones, the installation will save the cost of retrofitting the machines for the HCFC-123 refrigerant as mentioned previously. The cost of this retrofit was estimated to be $384,882 on page E-29. This value was used in the life cycle cost analysis as a non-recurring savings for each alternative.

E. Cost Estimates

The total installation costs for each alternative chiller mentioned in this ECO were estimated on pages E-30 through E-33. These costs were used in the life cycle cost analysis for each alternative. The results of the costs estimates were as follows:

Alternative	Chiller Type	Estimated Cost
C1	Electric Centrifugal	$479,191
C2	Electric Centrifugal & VFD	$633,919
C3	Electric Screw	$653,398
C4	Gas Driven Centrifugal	$765,561

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on each chiller alternative for this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for each life cycle cost analysis is shown on pages E-34 through E-37. The results of the alternative life cycle cost analysis were as follows:

Alternative	Chiller Type	Payback Years	SIR
C1	Electric Centrifugal	8.4	1.98
C2	Electric Centrifugal & VFD	10.7	1.54
C3	Electric Screw	12.2	1.37
C4	Gas Driven Centrifugal	10.0	1.51

Since the electric centrifugal chillers have the highest SIR, they are recommended as the most economical choice to replace the existing machines. The data from the life cycle cost analysis for this alternative were included in the summary on page E-19.

REFERENCES

1. Per current EPA regulations on CFC refrigerants.
2. See Appendix G for chiller retrofit estimates from Northeastern Research And Engineering Corporation.
3. See Appendix B for Area 1300 cooling system load profile.
4. See Appendix B for computer model input assumptions and data, and energy consumption output data.
5. See Appendix C for building field data and existing HVAC system data.
6. See Appendix G for manufacturer's equipment performance data from York International.
7. See Appendix A for utility cost analysis data, used in the savings calculations.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-C1, FORT SAM HOUSTON, AREA 1300

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Area 1300	1983	329 KW	24	7	26	517,565	
Water Chiller	1	York, electric water cooled, centrifugal, 827 Tons, R-134a	Area 1300	New	479 KW	24	7	26	867,974	
Chilled Water Pump	1	Allis Chalmers 775 gpm, 114 ft 40 HP	Area 1300	1983	29.84 KW	24	7	26	85,104	
Chilled Water Pump	1	1670 gpm, 114 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Condenser Water Pump	1	Allis Chalmers 1314 gpm, 30 ft 30 HP	Area 1300	1983	22.38 KW	24	7	26	63,828	
Condenser Water Pump	1	2785 gpm, 70 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Cooling Tower	1	Marley #324T induced draft, 2-35 HP fans	Area 1300	Exist.	52.22 KW	24	7	26	141,358	
Cooling Tower	1	Marley induced draft, 20 HP fan	Area 1300	Exist.	14.92 KW	24	7	26	37,204	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-C2, FORT SAM HOUSTON, AREA 1300

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Area 1300	1983	329 KW	24	7	26	517,565	
Water Chiller	1	York, electric, VFD water cooled, centrifugal, 827 Tons, R-134a	Area 1300	New	479 KW	24	7	26	811,935	
Chilled Water Pump	1	Allis Chalmers 775 gpm, 114 ft 40 HP	Area 1300	1983	29.84 KW	24	7	26	85,104	
Chilled Water Pump	1	1670 gpm, 114 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Condenser Water Pump	1	Allis Chalmers 1314 gpm, 30 ft 30 HP	Area 1300	1983	22.38 KW	24	7	26	63,828	
Condenser Water Pump	1	2785 gpm, 70 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Cooling Tower	1	Marley #324T induced draft, 2-35 HP fans	Area 1300	Exist.	52.22 KW	24	7	26	141,412	
Cooling Tower	1	Marley induced draft, 20 HP fan	Area 1300	Exist.	14.92 KW	24	7	26	37,204	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-C3, FORT SAM HOUSTON, AREA 1300

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Area 1300	1983	329 KW	24	7	26	517,565	
Water Chiller	1	York, electric water cooled, dual screw 827 Tons, R-134a	Area 1300	New	529 KW	24	7	26	916,945	
Chilled Water Pump	1	Allis Chalmers 775 gpm, 114 ft 40 HP	Area 1300	1983	29.84 KW	24	7	26	85,104	
Chilled Water Pump	1	1670 gpm, 114 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Condenser Water Pump	1	Allis Chalmers 1314 gpm, 30 ft 30 HP	Area 1300	1983	22.38 KW	24	7	26	63,828	
Condenser Water Pump	1	2785 gpm, 70 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Cooling Tower	1	Marley #324T induced draft, 2-35 HP fans	Area 1300	Exist.	52.22 KW	24	7	26	143,448	
Cooling Tower	1	Marley induced draft, 20 HP fan	Area 1300	Exist.	14.92 KW	24	7	26	37,204	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-C4, FORT SAM HOUSTON, AREA 1300

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	Carrier #19DK 78942P water cooled, centrifugal, 438 tons, R-11	Area 1300	1983	329 KW	24	7	26	517,565	
Water Chiller	1	York, gas fired water cooled, centrifugal 827 Tons, R-134a	Area 1300	New	5,127 MBH	24	7	26		8,886
Chilled Water Pump	1	Allis Chalmers 775 gpm, 114 ft 40 HP	Area 1300	1983	29.84 KW	24	7	26	85,104	
Chilled Water Pump	1	1670 gpm, 114 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Condenser Water Pump	1	Allis Chalmers 1314 gpm, 30 ft 30 HP	Area 1300	1983	22.38 KW	24	7	26	63,828	
Condenser Water Pump	1	2785 gpm, 70 ft 75 HP	Area 1300	New	55.95 KW	24	7	26	151,513	
Cooling Tower	1	Marley #324T induced draft, 2-35 HP fans	Area 1300	Exist.	52.22 KW	24	7	26	141,358	
Cooling Tower	1	Marley induced draft, 20 HP fan	Area 1300	Exist.	14.92 KW	24	7	26	37,204	

1300 AREA

ITEM	EXISTING CENTRAL CHILLER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					524.9	541.9	549.8	556.5	540.7	371.9			1,464,005	
Water Chiller					165.4	210.0	305.1	347.3	234.0				130,286	
Water Chiller					286.9	267.5	299.6	319.9	290.4	193.8			595,685	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			131,773	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CHW Pump					18.6	18.6	18.6	18.6	18.6	18.6			82,358	
CND Pump					29.8	29.8	29.8	29.8	29.8	29.8			131,773	
CND Pump					29.8	29.8	29.8	29.8	29.8				31,153	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			98,830	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			210,817	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			60,215	
Totals					1193.3	1235.5	1370.6	1439.8	1281.2	752.0			3,019,253	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					8,950	12,355	13,706	14,398	12,812	5,640				

Total Demand 67,861 $/yr

Total Energy 10,305 MMBTU/yr (electric)

Total Energy MMBTU/yr (gas)

ITEM	ECO-C1: NEW ELECTRIC CENTRIFUGAL CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller					437.4	453.1	475.2	479.0	446.8	373.4			867,974	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			141,358	
Total (KW)					937.5	971.5	1033.3	1040.5	985.3	881.3			2,016,059	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					7,031	9,715	10,333	10,405	9,853	6,610				

Total Demand 53,947 $/yr

Demand Savings 13,914 $/yr

Energy Savings 3,424 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

ITEM	ECO-C2: NEW ELECTRIC CENTRIFUGAL CHILLER WITH VFD MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller					419.5	441.7	472.9	479.0	437.2	340.0			811,935	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			141,412	
Total (KW)					919.6	960.1	1031.0	1040.5	975.7	847.9			1,960,074	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					6,897	9,601	10,310	10,405	9,757	6,359				

Total Demand 53,329 $/yr

Demand Savings 14,532 $/yr

Energy Savings 3,615 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

ITEM	ECO-C3: NEW ELECTRIC SCREW CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller					483.0	500.4	524.8	529.0	493.4	412.3			916,945	
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			143,448	
Total (KW)					983.1	1018.8	1082.9	1090.5	1031.9	920.2			2,067,120	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					7,373	10,188	10,829	10,905	10,319	6,902				

Total Demand 56,516 $/yr

Demand Savings 11,345 $/yr

Energy Savings 3,250 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

ITEM	ECO-C4: NEW GAS ENGINE CENTRIFUGAL CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					268.8	287.1	326.8	330.2	307.2	276.6			517,565	
Water Chiller														8,886
CHW Pump					29.8	29.8	29.8	29.8	29.8	29.8			85,104	
CHW Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
CND Pump					22.4	22.4	22.4	22.4	22.4	22.4			63,828	
CND Pump					56.0	56.0	56.0	56.0	56.0	56.0			151,513	
Cooling Tower					14.9	14.9	14.9	14.9	14.9	14.9			37,204	
Cooling Tower					52.2	52.2	52.2	52.2	52.2	52.2			141,358	
Total (KW)					500.1	518.4	558.1	561.5	538.5	507.9			1,148,085	8,886
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					3,751	5,184	5,581	5,615	5,385	3,809				

Total Demand	29,325 $/yr	
Demand Savings	38,536 $/yr	
Energy Savings	6,386 MMBTU/yr	(electrical)
Energy Savings	-8,886 MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 1300 , BUILDING 1377, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 8/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-C, Upgrade Two Existing R-11 Chillers To Operate On R-123

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Retrofit of two existing R-11 chillers to use R-123	1	ea	160	$28.00	$4,480	$275,000	$275,000	$279,480
R-123 detection system	1	JOB				$5,000	$5,000	$5,000
Chiller 2 speed ventilation fan	1	ea	16	$25.00	$400	$1,185	$1,185	$1,585
Chiller ventilation louver	10	sqft	4	$28.00	$1,120	$27	$270	$1,390
Test & Balance	1	ea	4	$50.00	$200			$200
				SUBTOTAL	$6,200		$281,455	$287,655
				O & P @ 20%	$1,240		$56,291	$57,531
				SUBTOTAL	$7,440		$337,746	$345,186
				DESIGN @ 6%				$20,711
				SUBTOTAL				$365,897
				SIOH @ 5.5%				$18,985
				TOTAL				$384,882

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922
(817) 335-3000 * FAX (817) 335-1025

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 1300 , BUILDING 1377, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 8/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-C1, Replace Existing Central Chillers With New Water Cooled Centrifugal Chiller

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Pumps	2	EA	6	$24.64	$296			$296
Remove chillers	2	EA	40	$24.64	$1,971	$500	$1,000	$2,971
Install New Chiller 827 ton, water cooled, centrifugal, R-134a	1	EA	2,609	$24.64	$64,286	$226,800	$226,800	$291,086
Pipe Assembly And Valves	1	EA	168	$24.64	$4,140	$10,000	$10,000	$14,140
RECONNECT:								
Controls	1	JOB	190	$24.64	$4,682	$400	$400	$5,082
Electrical	1	JOB	92	$24.64	$2,267	$800	$800	$3,067
Refrigerant Detection System	1	JOB	20	$24.64	$493	$4,500	$4,500	$4,993
Water Pump 75 HP	2	EA	132	$24.64	$6,505	$13,500	$27,000	$33,505
Test & Balance and Start-up	1	JOB	100	$28.00	$2,800	$200	$200	$3,000
				SUBTOTAL	$87,440		$270,700	$358,140
				O & P @ 20%	$17,488		$54,140	$71,628
				SUBTOTAL	$104,928		$324,840	$429,768
				DESIGN @ 6%				$25,786
				SUBTOTAL				$455,554
				SIOH @ 5.5%				$23,637
				TOTAL				$479,191

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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 1300 , BUILDING 1377, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 8/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-C2, Replace Existing Central Chiller With New Centrifugal Chiller And Variable Frequency Drive (VFD)

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Pumps	2	EA	6	$24.64	$296			$296
Remove chillers	2	EA	40	$24.64	$1,971	$500	$1,000	$2,971
Install New Chiller 827 ton, water cooled, centrifugal, R-134a	1	EA	2,609	$24.64	$64,286	$226,800	$226,800	$291,086
Adder For VFD	1000	HP				$115	$115,000	$115,000
Pipe Assembly And Valves	1	EA	168	$24.64	$4,140	$10,000	$10,000	$14,140
RECONNECT:								
Controls	1	JOB	190	$24.64	$4,682	$400	$400	$5,082
Electrical	1	JOB	118	$24.64	$2,908	$800	$800	$3,708
Refrigerant Detection System	1	JOB	20	$24.64	$493	$4,500	$4,500	$4,993
Water Pump 75 HP	2	EA	132	$24.64	$6,505	$13,500	$27,000	$33,505
Test & Balance and Start-up	1	JOB	100	$28.00	$2,800	$200	$200	$3,000
				SUBTOTAL	$88,081		$385,700	$473,781
				O & P @ 20%	$17,616		$77,140	$94,756
				SUBTOTAL	$105,697		$462,840	$568,537
				DESIGN @ 6%				$34,112
				SUBTOTAL				$602,649
				SIOH @ 5.5%				$31,270
				TOTAL				$633,919

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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 1300 , BUILDING 1377, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 8/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-C3, Replace Existing Central Chillers With New Water Cooled Dual Screw Chillere

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Pumps	2	EA	6	$24.64	$296			$296
Remove chillers	2	EA	40	$24.64	$1,971	$500	$1,000	$2,971
Install New Chiller 827 ton, water cooled, dual screw, R-134a	1	EA	2,609	$24.64	$64,286	$357,000	$357,000	$421,286
Pipe Assembly And Valves	1	EA	168	$24.64	$4,140	$10,000	$10,000	$14,140
RECONNECT:								
Controls	1	JOB	190	$24.64	$4,682	$400	$400	$5,082
Electrical	1	JOB	92	$24.64	$2,267	$800	$800	$3,067
Refrigerant Detection System	1	JOB	20	$24.64	$493	$4,500	$4,500	$4,993
Water Pump 75 HP	2	EA	132	$24.64	$6,505	$13,500	$27,000	$33,505
Test & Balance and Start-up	1	JOB	100	$28.00	$2,800	$200	$200	$3,000
				SUBTOTAL	$87,440		$400,900	$488,340
				O & P @ 20%	$17,488		$80,180	$97,668
				SUBTOTAL	$104,928		$481,080	$586,008
				DESIGN @ 6%				$35,160
				SUBTOTAL				$621,168
				SIOH @ 5.5%				$32,230
				TOTAL				$653,398

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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 1300 , BUILDING 1377, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 8/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-C4, Replace Existing Central Chillers With New Gas Engine Driven Chillere

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Pumps	2	EA	6	$24.64	$296			$296
Remove chillers	2	EA	40	$24.64	$1,971	$500	$1,000	$2,971
Install New Chiller 827 ton, water cooled centrifugal, R-134a, gas fired	1	EA	2,609	$24.64	$64,286	$436,800	$436,800	$501,086
Pipe Assembly And Valves	1	EA	168	$24.64	$4,140	$10,000	$10,000	$14,140
RECONNECT:								
Controls	1	JOB	190	$24.64	$4,682	$400	$400	$5,082
Electrical	1	JOB	92	$24.64	$2,267	$800	$800	$3,067
Refrigerant Detection System	1	JOB	20	$24.64	$493	$4,500	$4,500	$4,993
Water Pump 75 HP	2	EA	132	$24.64	$6,505	$13,500	$27,000	$33,505
GAS PIPING	1	JOB	62	$24.64	$1,528	$2,500	$2,500	$4,028
Test & Balance and Start-up	1	JOB	100	$28.00	$2,800	$200	$200	$3,000
SUBTOTAL					$88,968		$483,200	$572,168
O & P @ 20%					$17,794		$96,640	$114,434
SUBTOTAL					$106,762		$579,840	$686,602
DESIGN @ 6%								$41,196
SUBTOTAL								$727,798
SIOH @ 5.5%								$37,763
TOTAL								$765,561

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LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C1
ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 429768.		
B. SIOH	$ 23637.		
C. DESIGN COST	$ 25786.		
D. TOTAL COST (1A+1B+1C)	$ 479191.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 479191.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	3424.	$ 21503.	15.08	$ 324261.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 13914.	14.88	$ 207040.
N. TOTAL		3424.	$ 35417.		$ 531301.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2275.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 33852.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 384882.	0	1.00	384882.
d. TOTAL	$ 384882.			384882.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 418734.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 56936.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.42 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 950035.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.98
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 6.59 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C2
ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 568537.			
B. SIOH	$ 31270.			
C. DESIGN COST	$ 34112.			
D. TOTAL COST (1A+1B+1C)	$ 633919.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 633919.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	3615.	$ 22702.	15.08	$ 342349.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 14532.	14.88	$ 216236.
N. TOTAL		3615.	$ 37234.		$ 558585.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2275.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 33852.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 384882.	0	1.00	384882.
d. TOTAL	$ 384882.			384882.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 418734.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 58753.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.79 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 977319.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.54
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.25 %

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C3
ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT
A. CONSTRUCTION COST $ 586008.
B. SIOH $ 32230.
C. DESIGN COST $ 35160.
D. TOTAL COST (1A+1B+1C) $ 653398.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 653398.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	3250.	$ 20410.	15.08	$ 307783.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 11345.	14.88	$ 168814.
N. TOTAL		3250.	$ 31755.		$ 476596.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2275.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 33852.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 384882.	0	1.00	384882.
d. TOTAL	$ 384882.			384882.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 418734.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 53274.

5. SIMPLE PAYBACK PERIOD (1G/4) 12.26 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 895330.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.37
(IF < 1 PROJECT DOES NOT QUALIFY)
*** Project does not qualify for ECIP funding; 4,5,6 for information only.

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): N/A

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-C4
ANALYSIS DATE: 08-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 686602.		
B. SIOH	$ 37763.		
C. DESIGN COST	$ 41196.		
D. TOTAL COST (1A+1B+1C)	$ 765561.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 765561.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	6386.	$ 40104.	15.08	$ 604770.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	-8886.	$ -23637.	18.58	$ -439171.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 38536.	14.88	$ 573416.
N. TOTAL		-2500.	$ 55003.		$ 739014.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 2275.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 33852.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 384882.	0	1.00	384882.
d. TOTAL	$ 384882.			384882.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 418734.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 76522.

5. SIMPLE PAYBACK PERIOD (1G/4) 10.00 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 1157748.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.51
(IF < 1 PROJECT DOES NOT QUALIFY)

8. ADJUSTED INTERNAL RATE OF RETURN (AIRR): 5.15 %

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	D
DATE:	6/15/95
ECO TITLE:	Replace Existing Central Boilers With High Efficiency Modular Boilers
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 1300, Building 1377

A. Summary:

Electrical Energy Savings	712	MMBTU/yr
Electrical Demand Savings	1,847	$/yr
Gas Energy Savings	4,020	MMBTU/yr
Total Energy Savings	4,732	MMBTU/yr
Total Cost Savings	17,012	$/yr
Total Investment	163,724	$
Simple Payback	9.6	yrs
SIR	1.79	

B. ECO Description:

Remove the two existing watertube boilers and single 40 HP heating water (HW) distribution pump in building 1377, which are serving building 1350. Also remove the two existing firetube boilers and the two 15 HP distribution pumps in building 1377 which serve buildings 1374, 1375, 1379, 1380, 1382, 1377 and 1385. Connect the two separate distribution loops together in building 1377 with new HW supply and return headers to make a single HW distribution system. Install four new modular high efficiency boilers, rated at 1,830 MBH output each and four new 7 ½ HP distribution pumps to serve this single system. The existing electrical service and controls should be reused as much as possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180°F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

C. Discussion:

The two existing watertube boilers serving building 1350 were installed in 1983 and are rated at 5,317 MBH and 4,336 MBH output capacity. The single 40 HP pump circulates HW from these boilers through building 1350. The two existing firetube boilers serving the other buildings in the 1300 area were installed in 1972 and are rated at 5,912 MBH output capacity each. Two 15 HP pumps circulate HW from these boilers to the seven other buildings listed above. All these boilers appear to be in fair condition. Computer simulations of the eight buildings served by these boilers determined that the current combined capacity of 21,477 MBH is about three times the amount required to adequately heat the buildings[1]. The existing boilers are therefore operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the large boilers, excessive pumping energy is expended. By combining the two distribution systems together and staging four new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 7,320 MBH is recommended to more closely match the heating load in the eight buildings and reduce the associated pumping energy consumption.

D. Savings Calculations:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program[2]. The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[3].

The four new high efficiency, modular type boilers modeled were rated at 1,830 MBH output each. Full and part load performance data from Aerco International were used in the computer simulations of the new boiler energy usages[4]. An equipment list with specific data on the new boilers and pumps used in the computer simulation is shown on page D-40.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings[5]. These savings calculations are shown on page D-41. The demand and energy savings values were used in the life cycle cost analysis for this ECO. The results of these savings calculations were as follows:

New Boiler Type	Gas Savings MMBTU/yr	Electrical Savings MMBTU/yr	Demand Savings $/yr
Modular, High Efficiency	4,020	712	1,847

E. Cost Estimates

The total installation costs for this ECO were estimated on page D-42. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page D-43. The data from the life cycle cost analysis were included in the summary on page D-38.

REFERENCES

1. See Appendix for Area 1300 heating system load profile.
2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
3. See Appendix C for building field data and existing HVAC system data.
4. See Appendix G for manufacturer's equipment performance data from Aerco International.
5. See Appendix A for utility cost analysis data, used in the savings calculations.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-D, FORT SAM HOUSTON, AREA 1300

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Hot Water Boiler	4	Aerco #KC-2000 GWB natural draft, watertube 1830 MBH output	Area 1300	New	2,000 MBH	24	7	26		14,731
Heating Water Pump	4	Aurora 100 gpm, 80 ft 7.5 HP	Area 1300	New	5.60 KW	24	7	26	50,529	

ITEM	EXISTING CENTRAL BOILER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Watertube Boiler														3,140
Firetube Boiler	7.5	7.5	7.5	7.5							7.5	7.5	32,406	15,611
HW Pump	29.8	29.8	29.8	29.8							29.8	29.8	129,625	
HW Pump	11.2	11.2	11.2	11.2							11.2	11.2	48,609	
HW Pump	11.2	11.2	11.2	11.2							11.2	11.2	48,609	
Totals	59.7	59.7	59.7	59.7							59.7	59.7	259,249	18,751
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	448	448	448	448							448	448		

Total Demand	2,687 $/yr	
Total Energy	885 MMBTU/yr	(electric)
Total Energy	18,751 MMBTU/yr	(gas)

ITEM	ECO-D: NEW CENTRAL HIGH EFFICIENCY MODULAR BOILERS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Modular Boiler														8,632
Modular Boiler														3,976
Modular Boiler														1,919
Modular Boiler														204
HW Pump	5.6	5.6	5.6	5.6							5.6	5.6	24,326	
HW Pump	5.6	5.6	5.6	5.6							5.6	5.6	15,742	
HW Pump	5.6	5.6	5.6								5.6	5.6	7,504	
HW Pump	5.6	5.6										5.6	2,957	
Total (KW)	22.4	22.4	16.8	11.2							16.8	22.4	50,529	14,731
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	168	168	126	84							126	168		

Total Demand	840 $/yr	
Demand Savings	1,847 $/yr	
Energy Savings	712 MMBTU/yr	(electric)
Energy Savings	4,020 MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 1300 , BUILDING 1377, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-D, Replace Existing Central Boilers With High Efficiency Modular Boilers

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Boilers	4	EA	60	$24.64	$5,914	$500	$2,000	$7,914
Remove Pumps	3	EA	6	$24.64	$444			$444
Install New Boilers, AERCO # KC 2000 GWB , Water Tube 1830 MBH	4	EA	80	$24.64	$7,885	$18,000	$72,000	$79,885
Install New Pump	4	EA	11	$24.64	$1,084	$1,670	$6,680	$7,764
pipe Assembly & valves Boiler	4	JOB	28	$24.64	$2,760	$2,400	$9,600	$12,360
pipe Assembly & valves Pump	4	EA	9	$24.64	$887	$350	$1,400	$2,287
Boiler Breaching Stainless Steel	40	LF	2	$24.64	$1,971	$147	$5,880	$7,851
Reconnect Controls	4	JOB	10	$24.64	$986	$55	$220	$1,206
Reconnect Electrical	4	JOB	6	$26.64	$639	$64	$256	$895
Reconnect Chemical system	4	JOB	5	$26.64	$533	$50	$200	$733
Test , Balance & Start-up	4	LS	10	$25.64	$1,026			$1,026
				SUBTOTAL	$24,129		$98,236	$122,365
				O & P @ 20%	$4,826		$19,647	$24,473
				SUBTOTAL	$28,955		$117,883	$146,838
				DESIGN @ 6%				$8,810
				SUBTOTAL				$155,648
				SIOH @ 5.5%				$8,076
				TOTAL				$163,724

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922
(817) 335-3000 * FAX (817) 335-1025

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-D
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 146838.			
B. SIOH	$ 8076.			
C. DESIGN COST	$ 8810.			
D. TOTAL COST (1A+1B+1C)	$ 163724.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 163724.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	712.	$ 4471.	15.08	$ 67428.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	4020.	$ 10693.	18.58	$ 198680.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 1847.	14.88	$ 27483.
N. TOTAL		4732.	$ 17012.		$ 293591.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 17012.

5. SIMPLE PAYBACK PERIOD (1G/4) 9.62 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 293591.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.79
(IF < 1 PROJECT DOES NOT QUALIFY)

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	E
DATE:	6/15/95
ECO TITLE:	Replace Existing Central Chiller With New Electric Centrifugal Chiller
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 2200, Building 2265

A. Summary:

Electrical Energy Savings	1,304	MMBTU/yr
Electrical Demand Savings	11,822	\$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	1,304	MMBTU/yr
Total Cost Savings	37,433	\$/yr
Total Investment	237,078	\$
Simple Payback	6.3	yrs
SIR	2.73	

B. ECO Description:

Remove the existing 675 ton, R-11 centrifugal chiller in building 2265 and replace it with a 555 ton, R-134a centrifugal chiller. The existing 100 HP chilled water (CHW) pump, 50 HP condenser water (CND) pump and 40 HP cooling tower will be reused. The new chiller should be connected into the distribution piping at the existing chiller location. All existing controls and electrical services should be reconnected where possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. To meet the current ASHRAE Standard 15, a refrigerant detection and ventilation system should be installed. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

C. Discussion:

The existing water cooled, centrifugal chiller was installed in 1973 and serves as the primary cooling system for the four large buildings in the 2200 area. It appears to be in fair condition but uses the R-11 refrigerant, which will no longer be manufactured as of January 1, 1996[1]. To avoid the anticipated increasing operational costs over the life of this machine, it should either be retrofitted to use an approved refrigerant or replaced with a new machine that operates on one. The existing centrifugal machine can be retrofitted with no loss of capacity by replacing the impeller with one designed for HCFC-123 refrigerant. A company which produces these new impellers for existing R-11 centrifugal machines has provided cost estimates[2]. However, since the machine is already 22 years old, it is recommended that the facility replace it instead. A life cycle cost analysis performed on four different types of replacement chillers available determined that an electric centrifugal chiller using R-134a would be the most economical choice over the life of the new machine. Computer simulations of the buildings served by this machine determined that the current installed capacity of 657 tons is more than what is required to adequately cool the buildings[3]. Therefore, the new chiller should only be sized for 555 tons to more closely match the cooling load of the four buildings.

D. Savings Calculations:

1. *Energy Consumption And Savings*

The monthly peak demand and energy consumptions of the existing and proposed alternative chillers and auxiliary equipment were calculated using the Trace 600 computer program[4]. The buildings served by the existing chiller were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[5].

The 555 ton chiller alternatives which were compared included an electric centrifugal machine, an electric centrifugal with a variable frequency drive, a dual screw machine and a gas driven centrifugal machine. All proposed machines used R-134a. Full and part load performance data from York International were used in the computer simulations of the new chiller energy usages[6]. Equipment lists of the specific chillers and auxiliaries for each alternative modeled by the computer are shown on pages D-47 To D-50.

Once the computer simulations were completed, the total annual demand cost and energy consumption of each alternative were compared with that of the existing systems to determine the annual savings for each[7]. These savings calculations are shown on pages D-51 and D-52. The demand and energy savings values were used in the life cycle cost analysis for each alternative. The results of these savings calculations were as follows:

Alternative	Chiller Type	Demand Savings $/yr	Electrical Savings MMBTU/yr	Gas Savings MMBTU/yr
E1	Electric Centrifugal	11,822	1,304	0
E2	Electric Centrifugal & VFD	12,188	1,498	0
E3	Electric Screw	10,102	1,236	0
E4	Gas Driven Centrifugal	28,597	3,394	-6,578

2. *Maintenance Cost Savings*:

By installing a new chiller in place of the existing one, the installation will save the cost of retrofitting the machine for the HCFC-123 refrigerant as mentioned previously. The cost of this retrofit was estimated to be $348,435 on page D-53. This value was used in the life cycle cost analysis as a non-recurring savings for each alternative.

E. Cost Estimates

The total installation costs for each alternative chiller mentioned in this ECO were estimated on pages D-54 through D-57. These costs were used in the life cycle cost analysis for each alternative. The results of the costs estimates were as follows:

Alternative	Chiller Type	Estimated Cost
E1	Electric Centrifugal	$237,078
E2	Electric Centrifugal & VFD	$277,051
E3	Electric Screw	$240,791
E4	Gas Driven Centrifugal	$619,177

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on each chiller alternative for this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for each life cycle cost analysis is shown on pages D-58 through D-61. The results of the alternative life cycle cost analysis were as follows:

Alternative	Chiller Type	Payback Years	SIR
E1	Electric Centrifugal	6.3	2.73
E2	Electric Centrifugal & VFD	7.1	2.42
E3	Electric Screw	6.8	2.56
E4	Gas Driven Centrifugal	12.4	1.24

Since the electric centrifugal chiller has the highest SIR, it is recommended as the most economical choice to replace the existing machine. The data from the life cycle cost analysis for this alternative were included in the summary on page D-44.

REFERENCES

1. Per current EPA regulations on CFC refrigerants.
2. See Appendix G for chiller retrofit estimates from Northeastern Research And Engineering Corporation.
3. See Appendix B for Area 2200 cooling system load profile.
4. See Appendix B for computer model input assumptions and data, and energy consumption output data.
5. See Appendix C for building field data and existing HVAC system data.
6. See Appendix G for manufacturer's equipment performance data from York International.
7. See Appendix A for utility cost analysis data, used in the savings calculations.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E1, FORT SAM HOUSTON, AREA 2200

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York water cooled, centrifugal, 555 tons, R-134a	Area 2200	New	322 KW	24	7	26	611,543	
Chilled Water Pump	1	Paco 1526 gpm, 166 ft 100 HP	Area 2200	1973	74.60 KW	24	7	26	329,433	
Condenser Water Pump	1	Paco 1971 gpm, 63 ft 50 HP	Area 2200	1973	37.30 KW	24	7	26	164,717	
Cooling Tower	1	Built-up crossflow, 2 cell 2-20HP fans	Area 2200	1973	29.84 KW	24	7	26	122,039	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E2, FORT SAM HOUSTON, AREA 2200

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York, electric, VFD water cooled, centrifugal 555 tons, R-134a	Area 2200	New	322 KW	24	7	26	554,847	
Chilled Water Pump	1	Paco 1526 gpm, 166 ft 100 HP	Area 2200	1973	74.60 KW	24	7	26	329,433	
Condenser Water Pump	1	Paco 1971 gpm, 63 ft 50 HP	Area 2200	1973	37.30 KW	24	7	26	164,717	
Cooling Tower	1	Built-up crossflow, 2 cell 2-20HP fans	Area 2200	1973	29.84 KW	24	7	26	121,861	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E3, FORT SAM HOUSTON, AREA 2200

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York water cooled, dual screw 555 tons, R-134a	Area 2200	New	355 KW	24	7	26	631,571	
Chilled Water Pump	1	Paco 1526 gpm, 166 ft 100 HP	Area 2200	1973	74.60 KW	24	7	26	329,433	
Condenser Water Pump	1	Paco 1971 gpm, 63 ft 50 HP	Area 2200	1973	37.30 KW	24	7	26	164,717	
Cooling Tower	1	Built-up crossflow, 2 cell 2-20HP fans	Area 2200	1973	29.84 KW	24	7	26	122,031	

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-E4, FORT SAM HOUSTON, AREA 2200

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	York, gas fired water cooled, centrifugal 555 tons, R-134a	Area 2200	New	3,663 MBH	24	7	26		6,578
Chilled Water Pump	1	Paco 1526 gpm, 166 ft 100 HP	Area 2200	1973	74.60 KW	24	7	26	329,433	
Condenser Water Pump	1	Paco 1971 gpm, 63 ft 50 HP	Area 2200	1973	37.30 KW	24	7	26	164,717	
Cooling Tower	1	Built-up crossflow, 2 cell 2-20HP fans	Area 2200	1973	29.84 KW	24	7	26	121,172	

2200 AREA

ITEM	EXISTING CENTRAL CHILLER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					481.0	522.3	568.8	596.6	535.0	368.3			994,146	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			121,471	
Totals					622.7	664.0	710.5	738.3	676.7	510.0			1,609,767	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					4,670	6,640	7,105	7,383	6,767	3,825				

Total Demand 36,390 $/yr

Total Energy 5,494 MMBTU/yr (electric)

Total Energy MMBTU/yr (gas)

ITEM	ECO-E1: NEW ELECTRIC CENTRIFUGAL CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					306.9	311.1	319.4	322.0	314.8	240.0			611,543	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			122,039	
Total (KW)					448.6	452.8	461.1	463.7	456.5	381.7			1,227,732	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					3,365	4,528	4,611	4,637	4,565	2,863				

Total Demand 24,568 $/yr

Demand Savings 11,822 $/yr

Energy Savings 1,304 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

ITEM	ECO-E2: NEW ELECTRIC CENTRIFUGAL CHILLER WITH VFD MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					297.8	304.5	317.9	322.0	310.5	216.8			554,847	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			121,861	
Total (KW)					439.5	446.2	459.6	463.7	452.2	358.5			1,170,858	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					3,296	4,462	4,596	4,637	4,522	2,689				

Total Demand 24,202 $/yr

Demand Savings 12,188 $/yr

Energy Savings 1,498 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

2200 AREA

ITEM	ECO-E3: NEW ELECTRIC SCREW CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					338.4	343.0	352.2	355.0	347.1	264.5			631,571	
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			122,031	
Total (KW)					480.1	484.7	493.9	496.7	488.8	406.2			1,247,752	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					3,601	4,847	4,939	4,967	4,888	3,047				

Total Demand 26,288 $/yr

Demand Savings 10,102 $/yr

Energy Savings 1,236 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

ITEM	ECO-E4: NEW GAS ENGINE CENTRIFUGAL CHILLER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller														6,578
CHW Pump					74.6	74.6	74.6	74.6	74.6	74.6			329,433	
CND Pump					37.3	37.3	37.3	37.3	37.3	37.3			164,717	
Cooling Tower					29.8	29.8	29.8	29.8	29.8	29.8			121,172	
Total (KW)					141.7	141.7	141.7	141.7	141.7	141.7			615,322	6,578
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					1,063	1,417	1,417	1,417	1,417	1,063				

Total Demand 7,794 $/yr

Demand Savings 28,597 $/yr

Energy Savings 3,394 MMBTU/yr (electric)

Energy Savings -6,578 MMBTU/yr (gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 2200, BUILDING 2265, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** CAP

PROJECT DESCRIPTION: ECO-E - Upgrade Existing R-11 Chiller To Operate With R-123

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Retrofit of existing R-11 chiller to use R-123	1	ea	80.00	$28.00	$2,240	$250,000	$250,000	$252,240
R-123 detection system	1	ea				$5,000	$5,000	$5,000
Chiller 2-speed ventilation fan	1	ea	16.00	$25.00	$400	$1,185	$1,185	$1,585
Chiller ventilation louver	10	sqft	4.00	$28.00	$1,120	$27	$270	$1,390
Test & balance	1	ea	4.00	$50.00	$200			$200
				SUBTOTAL	$3,960		$256,455	$260,415
				O & P @ 20%	$792		$51,291	$52,083
				SUBTOTAL	$4,752		$307,746	$312,498
				DESIGN @ 6%				$18,750
				SUBTOTAL				$331,248
				SIOH @ 5.5%				$17,187
				TOTAL				$348,435

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922
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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 2200, BUILDING 2265, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-E1, Replace Existing Central Chiller With New Centrifugal Chiller

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	60	$24.64	$1,478	$500	$500	$1,978
Install New Chiller 555 ton, water cooled centrifugal R-134a	1	EA	1,200	$24.64	$29,568	$130,425	$130,425	$159,993
Pipe Assembly And Valves	1	EA	63	$24.64	$1,552	$4,900	$4,900	$6,452
RECONNECT:								
Controls	1	JOB	65	$24.64	$1,602	$100	$100	$1,702
Electrical	1	JOB	33	$24.64	$813	$200	$200	$1,013
Refrigerant Detection System And Ventilation	1	JOB	41	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	30	$28.00	$840	$200	$200	$1,040
				SUBTOTAL	$36,863		$140,325	$177,188
				O & P @ 20%	$7,373		$28,065	$35,438
				SUBTOTAL	$44,236		$168,390	$212,626
				DESIGN @ 6%				$12,758
				SUBTOTAL				$225,384
				SIOH @ 5.5%				$11,694
				TOTAL				$237,078

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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 2200, BUILDING 2265, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-E2, Replace Existing Central Chiller With New Centrifugal Chiller And Variable Frequency Drive (VFD)

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	60.00	$24.64	$1,478	$500.00	$500	$1,978
Install New Chiller 555 ton, water cooled centrifugal R-134a	1	EA	1200.00	$24.64	$29,568	$130,425.00	$130,425	$159,993
Adder For VFD	1	LS				$29,875.00	$29,875	$29,875
Pipe Assembly And Valves	1	EA	63.00	$24.64	$1,552	$4,900.00	$4,900	$6,452
RECONNECT:								
Controls	1	JOB	65.00	$24.64	$1,602	$100.00	$100	$1,702
Electrical	1	JOB	33.00	$24.64	$813	$200.00	$200	$1,013
Refrigerant Detection System And Ventilation	1	JOB	41.00	$24.64	$1,010	$4,000.00	$4,000	$5,010
Test & Balance and Start-up	1	JOB	30.00	$28.00	$840	$200.00	$200	$1,040
				SUBTOTAL	$36,863		$170,200	$207,063
				O & P @ 20%	$7,373		$34,040	$41,413
				SUBTOTAL	$44,236		$204,240	$248,476
				DESIGN @ 6%				$14,909
				SUBTOTAL				$263,385
				SIOH @ 5.5%				$13,666
				TOTAL				$277,051

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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 2200, BUILDING 2265, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-E3, Replace Existing Central Chiller With Water Cooled, Dual Screw Chiller

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	60	$24.64	$1,478	$500	$500	$1,978
Install New Chiller 555 ton, water cooled, dual screw, R-134a	1	EA	1,200	$24.64	$29,568	$133,200	$133,200	$162,768
Pipe Assembly And Valves	1	EA	63	$24.64	$1,552	$4,900	$4,900	$6,452
RECONNECT:								
Controls	1	JOB	65	$24.64	$1,602	$100	$100	$1,702
Electrical	1	JOB	33	$24.64	$813	$200	$200	$1,013
Refrigerant Detection System And Ventilation	1	JOB	41	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	30	$28.00	$840	$200	$200	$1,040
				SUBTOTAL	$36,863		$143,100	$179,963
				O & P @ 20%	$7,373		$28,620	$35,993
				SUBTOTAL	$44,236		$171,720	$215,956
				DESIGN @ 6%				$12,957
				SUBTOTAL				$228,913
				SIOH @ 5.5%				$11,878
				TOTAL				$240,791

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ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 2200, BUILDING 2265, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-E4, Replace Existing Central Chiller With Gas Engine Driven Chiller

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	1	EA	60.00	$24.64	$1,478	$500	$500	$1,978
Install New Chiller 555 ton, water cooled centrifugal, R-134a, gas fired	1	EA	1200.00	$24.64	$29,568	$416,000	$416,000	$445,568
Pipe Assembly And Valves	1	EA	63.00	$24.64	$1,552	$4,900	$4,900	$6,452
RECONNECT:								
Controls	1	JOB	65.00	$24.64	$1,602	$100	$100	$1,702
Electrical	1	JOB	33.00	$24.64	$813	$200	$200	$1,013
Refrigerant Detection System And Ventilation	1	JOB	41.00	$24.64	$1,010	$4,000	$4,000	$5,010
Test & Balance and Start-up	1	JOB	30.00	$28.00	$840	$200	$200	$1,040
				SUBTOTAL	$36,863		$425,900	$462,763
				O & P @ 20%	$7,373		$85,180	$92,553
				SUBTOTAL	$44,236		$511,080	$555,316
				DESIGN @ 6%				$33,319
				SUBTOTAL				$588,635
				SIOH @ 5.5%				$30,542
				TOTAL				$619,177

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LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E1
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 212626.		
B. SIOH	$ 11694.		
C. DESIGN COST	$ 12758.		
D. TOTAL COST (1A+1B+1C)	$ 237078.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 237078.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	1304.	$ 8189.	15.08	$ 123492.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 11822.	14.88	$ 175911.
N. TOTAL		1304.	$ 20011.		$ 299403.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 348435.	0	1.00	348435.
d. TOTAL	$ 348435.			348435.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 348435.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 37433.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.33 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 647838.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.73
(IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: FSH

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)

INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY

FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E2

ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 248476.		
B. SIOH	$ 13666.		
C. DESIGN COST	$ 14909.		
D. TOTAL COST (1A+1B+1C)	$ 277051.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 277051.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	1498.	$ 9407.	15.08	$ 141864.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 12188.	14.88	$ 181357.
N. TOTAL		1498.	$ 21595.		$ 323222.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 348435.	0	1.00	348435.
d. TOTAL	$ 348435.			348435.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 348435.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 39017.

5. SIMPLE PAYBACK PERIOD (1G/4) 7.10 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 671657.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.42
(IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E3
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT
A. CONSTRUCTION COST $ 215956.
B. SIOH $ 11878.
C. DESIGN COST $ 12957.
D. TOTAL COST (1A+1B+1C) $ 240791.
E. SALVAGE VALUE OF EXISTING EQUIPMENT $ 0.
F. PUBLIC UTILITY COMPANY REBATE $ 0.
G. TOTAL INVESTMENT (1D - 1E - 1F) $ 240791.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	1236.	$ 7762.	15.08	$ 117052.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 10102.	14.88	$ 150318.
N. TOTAL		1236.	$ 17864.		$ 267370.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 348435.	0	1.00	348435.
d. TOTAL	$ 348435.			348435.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 348435.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 35286.

5. SIMPLE PAYBACK PERIOD (1G/4) 6.82 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 615805.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 2.56
(IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-E4
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 555316.	
B. SIOH	$ 30542.	
C. DESIGN COST	$ 33319.	
D. TOTAL COST (1A+1B+1C)	$ 619177.	
E. SALVAGE VALUE OF EXISTING EQUIPMENT	$ 0.	
F. PUBLIC UTILITY COMPANY REBATE	$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)		$ 619177.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	3394.	$ 21314.	15.08	$ 321420.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	-6578.	$ -17497.	18.58	$ -325103.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 28597.	14.88	$ 425523.
N. TOTAL		-3184.	$ 32414.		$ 421840.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)		$ 0.
(1) DISCOUNT FACTOR (TABLE A)	14.88	
(2) DISCOUNTED SAVING/COST (3A X 3A1)		$ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
1. REFRIG UPGRADE	$ 348435.	0	1.00	348435.
d. TOTAL	$ 348435.			348435.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 348435.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 49836.

5. SIMPLE PAYBACK PERIOD (1G/4) 12.42 YEAR.

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 770275.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.24
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	I
DATE:	6/15/95
ECO TITLE:	Replace Existing Individual Building Chillers With Central Chiller Plant
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 100, Building 250

A. Summary:

Electrical Energy Savings	2,816	MMBTU/yr
Electrical Demand Savings	19,781	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,816	MMBTU/yr
Total Cost Savings	64,465	$/yr
Total Investment	556,559	$
Simple Payback	8.6	yrs
SIR	1.73	

B. ECO Description:

Remove the 14 existing air cooled, reciprocating chillers serving buildings 122, 124, 125, 128, 133, 134, 135, 142, 143, 144, 146, 147, 149, 197, 198, 199 and 250. Install 6" chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 250, near the existing air cooled chiller installation. Install two new 210 ton, air cooled screw chillers behind building 250. Install two new 30 HP chilled water distribution pumps to circulate water from new chillers through new distribution loop. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 250 to serve the new chillers and pumps. Other specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chiller and installation of the new chiller, associated wiring and controls.

C. Discussion:

The 14 existing air cooled, reciprocating chillers in the 100 area were installed in 1985 and serves as the primary cooling systems for 17 buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also greatly reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 540 tons is more than is required to adequately cool the buildings[1]. Therefore, it is recommended that the two new chillers be rated at a combined 420 tons to more closely match the cooling load of the buildings.

D. Savings Calculations:

1. *Energy Consumption And Savings*

The monthly peak demand and energy consumptions of the existing and proposed chillers and pumps were calculated using the Trace 600 computer program[2]. The buildings served by the existing chillers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[3].

The 210 ton air cooled screw chillers which were modeled by the computer had better part load performance ratings than reciprocating machines and were chosen for that reason. Full and part load performance data from McQuay Incorporated were used in the computer simulations of the new chiller energy usages. An equipment list of the specific chillers and pumps modeled for the new central plant are shown on page D-64.

Once the computer simulations of the existing and new chiller plants were completed, the total annual demand cost and energy consumption of the new central plant was compared with that of the existing individual systems to determine the annual savings for this ECO[4]. These savings calculations are shown on pages D-65 and D-66. These demand and energy savings values were used in the life cycle cost analysis.

2. *Maintenance Cost Savings*:

Maintenance cost estimates were obtained from a local maintenance contractor and were used to estimate the maintenance savings from reducing the total number of air cooled chillers in this area from fourteen down to two[5]. Based on an annual maintenance cost of $2,250 per chiller, the total maintenance cost savings from this ECO is estimated to be $27,000 per year. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for the new central chiller plant were estimated on page D-67. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page D-68 . The data from the summary sheet were presented in the ECO summary on page D-62.

REFERENCES

1. See Appendix B for Area 100 cooling system load profile.
2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
3. See Appendix C for building field data and existing HVAC system data.
4. See Appendix A for utility cost analysis data, used in the savings calculations.
5. See Appendix G for maintenance contractor cost estimates for air cooled chillers.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-I, FORT SAM HOUSTON, AREA 100

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	McQuay, electric air cooled, single screw 210 Tons, R-134a	Area 100	New	240 KW	24	7	26	508,916	
Water Chiller	1	McQuay, electric air cooled, single screw 210 Tons, R-134a	Area 100	New	240 KW	24	7	26	220,753	
Chilled Water Pump	1	504 gpm, 150 ft 30 HP	Area 100	New	22.38 KW	24	7	26	98,830	
Chilled Water Pump	1	504 gpm, 150 ft 30 HP	Area 100	New	22.38 KW	24	7	26	33,570	

ITEM	EXISTING INDIVIDUAL CHILLER PLANTS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					47.5	53.0	56.9	56.3	47.8	35.0			92,395	
Water Chiller					58.3	64.4	69.1	68.0	57.9	42.2			112,912	
Water Chiller					28.4	29.7	30.8	30.6	28.6	26.3			12,045	
Water Chiller					37.5	42.4	44.8	44.4	38.6	27.0			76,773	
Water Chiller					49.6	51.8	53.8	53.3	49.8	45.5			104,024	
Water Chiller					61.4	66.6	71.5	72.2	62.9	49.7			113,775	
Water Chiller					61.4	66.6	71.5	72.2	62.9	49.7			113,775	
Water Chiller					59.0	64.1	68.9	69.7	60.6	47.5			107,387	
Water Chiller					70.0	76.4	85.0	83.4	74.2	56.3			170,355	
Water Chiller					60.4	65.5	70.3	70.6	61.9	49.6			113,383	
Water Chiller					16.1	17.3	17.9	17.8	16.6	12.9			30,616	
Water Chiller					21.6	23.9	26.2	26.6	22.6	16.0			43,319	
Water Chiller					117.2	122.9	133.5	137.3	118.3	87.7			346,860	
Water Chiller					13.8	15.3	16.5	16.7	14.0	9.8			26,626	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					0.4	0.4	0.4	0.4	0.4	0.4			1,634	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					2.2	2.2	2.2	2.2	2.2	2.2			9,892	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					1.5	1.5	1.5	1.5	1.5	1.5			6,580	
CHW Pump					1.1	1.1	1.1	1.1	1.1	1.1			4,946	
CHW Pump					1.5	1.5	1.5	1.5	1.5	1.5			6,580	
CHW Pump					5.6	5.6	5.6	5.6	5.6	5.6			24,730	
CHW Pump					0.8	0.8	0.8	0.8	0.8	0.8			3,312	
Air Cooled Comp.					8.0	8.3	8.6	8.6	8.0	7.4			12,232	
Compresser Fans					0.6	0.7	0.7	0.7	0.6	0.4			1,008	
Air Cooled Comp.					63.6	66.4	68.8	68.3	63.8	58.9			64,825	
Compresser Fans					4.5	4.8	6.2	6.2	4.6	3.6			6,524	
Totals					810.0	871.2	932.1	934.0	824.8	656.6			1,687,278	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					6,075	8,712	9,321	9,340	8,248	4,925				

Total Demand	46,621	$/yr	
Total Energy	5,759	MMBTU/yr	(electric)
Total Energy		MMBTU/yr	(gas)

ITEM	ECO-I: NEW CENTRAL AIR COOLED SCREW CHILLERS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					210.8	234.2	240.0	240.0	221.0	187.4			508,916	
Water Chiller					210.8	234.2	240.0	240.0	221.0	147.2			220,753	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			98,830	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			33,570	
Total (KW)					466.4	513.2	524.8	524.8	486.8	379.4			862,069	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					3,498	5,132	5,248	5,248	4,868	2,846				

Total Demand	26,840	$/yr	
Demand Savings	19,781	$/yr	
Energy Savings	2,816	MMBTU/yr	(electric)
Energy Savings		MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 100, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-I, Replace Existing Individual Building Chillers With Central Chiller Plant

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove chiller	14	EA	40	$24.64	$13,798	$500	$7,000	$20,798
Install New Chiller 210 ton, air-cooled, single screw R-22	2	EA	650	$23.64	$30,732	$73,500	$147,000	$177,732
Install New Chilled Water Pump 30 HP	2	EA	20	$24.64	$986	$3,957	$7,914	$8,900
REconnect Pump to Site Distribution	16	EA	6	$24.64	$2,365	$800	$12,800	$15,165
Pipe Assembly And Valves Chiller Assembly	2	EA	60	$24.64	$2,957	$3,300	$6,600	$9,557
Prefabricated Conduit 6" Trench & backfill	2950	LF	1	$24.64	$72,688	$17	$50,150	$122,838
Controls	1	JOB	390	$24.64	$9,610	$26,000	$26,000	$35,610
Electrical	1	JOB	192	$24.64	$4,731	$13,800	$13,800	$18,531
E quipment Yard Pads	1	JOB	120	$15.60	$1,872	$1,400	$1,400	$3,272
Test & Balance and Start-up	1	JOB	120	$28.00	$3,360	$200	$200	$3,560
				SUBTOTAL	$143,099		$272,864	$415,963
				O & P @ 20%	$28,620		$54,573	$83,193
				SUBTOTAL	$171,719		$327,437	$499,156
				DESIGN @ 6%				$29,949
				SUBTOTAL				$529,105
				SIOH @ 5.5%				$27,454
				TOTAL				$556,559

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
512 MAIN STREET, SUITE 1500
FORT WORTH, TEXAS 76102-3922

LIFE CYCLE COST ANALYSIS SUMMARY   STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)   LCCID FY95 (92)
INSTALLATION & LOCATION: FSH   REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504   EEAP BOILER CHILLER STUDY
FISCAL YEAR 96   DISCRETE PORTION NAME: ECO-I
ANALYSIS DATE: 06-16-95   ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 499156.		
B. SIOH	$ 27454.		
C. DESIGN COST	$ 29949.		
D. TOTAL COST (1A+1B+1C)	$ 556559.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 556559.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	2816.	$ 17684.	15.08	$ 266682.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 19781.	14.88	$ 294341.
N. TOTAL		2816.	$ 37465.		$ 561023.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 27000.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 401760.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 401760.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 64465.

5. SIMPLE PAYBACK PERIOD (1G/4) 8.63 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 962783.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.73
(IF < 1 PROJECT DOES NOT QUALIFY)

APPENDIX E

NON-RECOMMENDED ECO CALCULATIONS

APPENDIX E
NON-RECOMMENDED ECO CALCULATIONS

TABLE OF CONTENTS

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	B
DATE:	6/15/95
ECO TITLE:	Replace Existing Central Boilers With High Efficiency Modular Boiler
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 900, Building 902

A. Summary:

Electrical Energy Savings	0	MMBTU/yr
Electrical Demand Savings	0	$/yr
Gas Energy Savings	1,235	MMBTU/yr
Total Energy Savings	1,235	MMBTU/yr
Total Cost Savings	3,285	$/yr
Total Investment	50,591	$
Simple Payback	15.4	yrs
SIR	1.21	

B. ECO Description:

Remove the three existing watertube boilers in building 902 which are serving the 21 buildings in the 900 area. Install one new modular high efficiency boiler, rated at 1,830 MBH output in place of the existing boilers. Connect the new boiler to the existing distribution headers at the existing boiler location. The four existing heating water distribution pumps in building 902 should be reused. The existing electrical service and controls should be reused as much as possible. Other specific requirements in these areas should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing boilers, and installation of the new boilers, associated wiring and controls.

C. Discussion:

The three existing watertube boilers serving the 900 area buildings were installed in 1985 and are rated at 1,665 MBH output capacity each. The four existing pumps in 902 circulate HW from these boilers through the buildings. All these boilers and pumps appear to be in fair condition. Computer simulations of the 21 buildings served by these boilers determined that the current combined capacity of 4,995 MBH is about 2 ½ times the amount required to adequately heat the buildings[1]. The existing boilers are therefore operating at an inefficient, low load condition most of the time. The new high efficiency modular boiler is designed to maintain extremely high efficiencies even at very low load conditions and is therefore recommended to replace the existing boilers. The decrease in the boiler output capacity to 1,830 MBH is recommended to more closely match the heating load in the buildings.

D. Savings Calculations:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program[2]. The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[3].

The new high efficiency, modular type boiler modeled was rated at 1,830 MBH output. Full and part load performance data from Aerco International were used in the computer simulations of the new boiler energy usage[4]. An equipment list with specific data on the new boiler and existing pumps used in the

computer simulation is shown on page E-3.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings[5]. These savings calculations are shown on page E-4. The demand and energy savings values were used in the life cycle cost analysis for this ECO.

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-5. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-6. The data from the life cycle cost analysis were included in the summary on page E-1.

REFERENCES

1. See Appendix B for Area 900 heating system load profile.
2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
3. See Appendix C for building field data and existing HVAC system data.
4. See Appendix G for manufacturer's equipment performance data from Aerco International.
5. See Appendix A for utility cost analysis data, used in the savings calculations.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-B, FORT SAM HOUSTON, AREA 900

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Hot Water Boiler	1	Aerco #KC-2000 GWB natural draft, watertube 1,758 MBH output	Area 900	New	2,000 MBH	24	7	26		6,574
Heating Water Pump	1	Weinman 200 gpm, 38 ft 5 HP	Area 900	Exist	3.73 KW	24	7	26	32,675	
Heating Water Pump	1	Weinman 115 gpm, 30 ft 5 HP	Area 900	Exist	3.73 KW	24	7	26	32,675	
Heating Water Pump	1	Weinman 115 gpm, 30 ft 2 HP	Area 900	Exist	1.49 KW	24	7	26	13,052	
Heating Water Pump	1	Peerless 1.5 HP	Bldg. 902	Exist	1.12 KW	24	7	26	9,811	

900 AREA

ITEM	EXISTING CENTRAL BOILER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Watertube Boiler														7,809
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	13,052	
HW Pump	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	9,811	
Totals	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	88,213	7,809
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	75	75	75	75	75	100	100	100	100	75	75	75		

Total Demand	1,000 $/yr	
Total Energy	301 MMBTU/yr	(electric)
Total Energy	7,809 MMBTU/yr	(gas)

ITEM	ECO-B: NEW CENTRAL HIGH EFFICIENCY BOILER MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Modular Boiler														6,57
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	32,675	
HW Pump	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	13,052	
HW Pump	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	9,811	
Total (KW)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	88,213	6,57
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	75	75	75	75	75	100	100	100	100	75	75	75		

Total Demand	1,000 $/yr	
Demand Savings	$/yr	
Energy Savings	MMBTU/yr	(electric)
Energy Savings	1,235 MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 900 , BUIDING 902, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-B, Replace Existing Central Boilers With New High Efficiency Modular Boiler

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Boilers	3	EA	60	$24.64	$4,435	$500	$1,500	$5,935
Install New Boiler, AERCO # KC 2000 GWB, Water Tube 1758 MBH	1	EA	80	$24.64	$1,971	$18,000	$18,000	$19,971
pipe Assembly & valves	1	JOB	28	$24.64	$690	$2,400	$2,400	$3,090
Boiler Breaching Stainless steel	40	LF	2	$24.64	$1,971	$147	$5,880	$7,851
Reconnect Controls	1	JOB	10	$24.64	$246	$55	$55	$301
Reconnect Electrical	1	JOB	6	$26.64	$160	$64	$64	$224
Reconnect Chemical system	1	JOB	5	$26.64	$133	$50	$50	$183
Test , Balance & Start-up	1	LS	10	$25.64	$256			$256
				SUBTOTAL	$9,862		$27,949	$37,811
				O & P @ 20%	$1,972		$5,590	$7,562
				SUBTOTAL	$11,834		$33,539	$45,373
				DESIGN @ 6%				$2,722
				SUBTOTAL				$48,095
				SIOH @ 5.5%				$2,496
				TOTAL				$50,591

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LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-B
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 45373.		
B. SIOH	$ 2496.		
C. DESIGN COST	$ 2722.		
D. TOTAL COST (1A+1B+1C)	$ 50591.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 50591.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	0.	$ 0.	15.08	$ 0.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	1235.	$ 3285.	18.58	$ 61037.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 0.	14.88	$ 0.
N. TOTAL		1235.	$ 3285.		$ 61037.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 3285.

5. SIMPLE PAYBACK PERIOD (1G/4) 15.40 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 61037.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= 1.21
(IF < 1 PROJECT DOES NOT QUALIFY)

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	F
DATE:	6/15/95
ECO TITLE:	Replace Existing Central Boilers With High Efficiency Modular Boilers
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 2200, Building 2265

A. Summary:

Electrical Energy Savings	38	MMBTU/yr
Electrical Demand Savings	378	$/yr
Gas Energy Savings	910	MMBTU/yr
Total Energy Savings	948	MMBTU/yr
Total Cost Savings	3,037	$/yr
Total Investment	78,553	$
Simple Payback	25.8	yrs
SIR	0.69	

B. ECO Description:

Remove the three existing watertube boilers and three 15 HP heating water (HW) distribution pumps in building 2265, which are serving four large buildings in the 2200 area. Install two new modular high efficiency boilers, rated at 1,830 MBH and 915 MBH output, and two new HW distribution pumps, one rated at 7 ½ HP and the other at 5 HP. Connect the new boilers and pumps to the distribution piping at the existing boiler and pump locations. The existing electrical service and controls should be reused as much as possible. Specific requirements in these areas should be determined by the design engineer responsible for this project. The boilers and pumps should be sequenced to operate only as needed to maintain the supply water temperature setpoint of approximately 180°F. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and pumps, and installation of the new boilers, pumps, associated wiring and controls.

C. Discussion:

The three existing watertube boilers serving the 2200 area buildings were installed in 1988 and are rated at 2,240 MBH output capacity each. The three 15 HP pumps circulate HW from these boilers through buildings 2263, 2264, 2265 and 2266. All these boilers appear to be in fair condition. Computer simulations of the four buildings served by these boilers determined that the current combined capacity of 6,720 MBH is over two times the amount required to adequately heat the buildings[6]. The existing boilers are therefore operating at an inefficient, low load condition most of the time. Also, because of the constant flow rate requirements of the boilers, excessive pumping energy is expended. By staging two new high efficiency modular boilers to operate only as needed, a substantial energy savings can be realized. Also, a decrease in the combined boiler output capacity to 2,745 MBH is recommended to more closely match the heating load in the buildings and reduce the associated pumping energy consumption.

D. Savings Calculations:

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program[7]. The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[8].

The two new high efficiency, modular type boilers modeled were rated at 1,830 MBH and 915 MBH output. Full and part load performance data from Aerco International were used in the computer simulations of the new boiler energy usages[9]. An equipment list with specific data on the new boilers and pumps used in the computer simulation is shown on page E-9.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings[10]. These savings calculations are shown on page E-10. The demand and energy savings values were used in the life cycle cost analysis for this ECO. The results of these savings calculations were as follows:

New Boiler Type	Gas Savings MMBTU/yr	Electrical Savings MMBTU/yr	Demand Savings $/yr
Modular, High Efficiency	910	38	378

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-11. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-12. The data from the life cycle cost analysis were included in the summary on page E-7.

REFERENCES

6. See Appendix B for Area 2200 heating system load profile.
7. See Appendix B for computer model input assumptions and data, and energy consumption output data.
8. See Appendix C for building field data and existing HVAC system data.
9. See Appendix G for manufacturer's equipment performance data from Aerco International.
10. See Appendix A for utility cost analysis data, used in the savings calculations.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-F, FORT SAM HOUSTON, AREA 2200

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Hot Water Boiler	1	Aerco #KC-2000 GWB natural draft, watertube 1830 MBH output	Area 2200	New	2,000 MBH	24	7	26		3,983
Hot Water Boiler	1	Aerco #KC-1000 GWB natural draft, watertube 915 MBH output	Area 2200	New	1,000 MBH	24	7	26		56
Heating Water Pump	1	166 gpm, 110 ft 7.5 HP	Area 2200	New	5.60 KW	24	7	26	24,326	
Heating Water Pump	1	83 gpm, 110 ft 5 HP	Area 2200	New	3.73 KW	24	7	26	16,203	

2200 AREA

ITEM	EXISTING CENTRAL BOILER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Watertube Boiler														4,936
Watertube Boiler														13
HW Pump	11.2	11.2	11.2	11.2							11.2	11.2	48,609	
HW Pump	0.6	0.6	0.6	0.6							0.6	0.6	2,433	
HW Pump	11.2	11.2										11.2	470	
HW Pump	0.6	0.6										0.6	24	
Totals	23.6	23.6	11.8	11.8							11.8	23.6	51,536	4,949
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	177	177	89	89							89	177		

Total Demand	797 $/yr	
Total Energy	176 MMBTU/yr	(electric)
Total Energy	4,949 MMBTU/yr	(gas)

ITEM	ECO-F: NEW CENTRAL HIGH EFFICIENCY MODULAR BOILERS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Modular Boiler														3,983
Modular Boiler														56
HW Pump	5.6	5.6	5.6	5.6							5.6	5.6	24,326	
HW Pump	3.7	3.7	3.7	3.7							3.7	3.7	16,203	
Total (KW)	9.3	9.3	9.3	9.3							9.3	9.3	40,529	4,039
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	70	70	70	70							70	70		

Total Demand	419 $/yr	
Demand Savings	378 $/yr	
Energy Savings	38 MMBTU/yr	(electric)
Energy Savings	910 MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 2200, BUILDING 2265, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-F, Replace Existing Central Boilers With High Efficiency Modular Boilers

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Remove Boiler	3	EA	60.00	$24.64	$4,435	$500.00	$1,500	$5,935
Remove Pump	3	EA	6.00	$24.64	$444			$444
Install New Boiler								
AERCO # KC 2000 GWB Natural Draft , Water Tube 1830 MBH	1	EA	81.00	$24.64	$1,996	$18,001.00	$18,001	$19,997
AERCO # KC 1000 GWB Natural Draft , Water Tube 915 MBH	1	EA	40.00	$24.64	$986	$12,000.00	$12,000	$12,986
Install New Pump 7.5 Hp	1	EA	11.00	$24.64	$271	$1,669.00	$1,669	$1,940
Install New Pump 5.0 HP	1	EA	10.00	$24.64	$246	$1,600.00	$1,600	$1,846
Pipe Assembly & valves Boiler	1	JOB	42.00	$24.64	$1,035	$3,600.00	$3,600	$4,635
Pipe Assembly & valves Pump	2	EA	9.00	$24.64	$444	$350.00	$700	$1,144
Boiler Breaching Stainless steel	40	LF	2.00	$24.64	$1,971	$147.00	$5,880	$7,851
Reconnect Controls	1	JOB	20.00	$24.64	$493	$55.00	$55	$548
Reconnect Electrical	1	JOB	16.00	$24.64	$394	$200.00	$200	$594
Reconnect Chemical system	1	JOB	10.00	$24.64	$246	$50.00	$50	$296
Test , Balance & Start-up	1	LS	20.00	$24.64	$493			$493
				SUBTOTAL	$13,454		$45,255	$58,709
				O & P @ 20%	$2,691		$9,051	$11,742
				SUBTOTAL	$16,145		$54,306	$70,451
				DESIGN @ 6%				$4,227
				SUBTOTAL				$74,678
				SIOH @ 5.5%				$3,875
				TOTAL				$78,553

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LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-F
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 70451.		
B. SIOH	$ 3875.		
C. DESIGN COST	$ 4227.		
D. TOTAL COST (1A+1B+1C)	$ 78553.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 78553.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	38.	$ 239.	15.08	$ 3599.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	910.	$ 2421.	18.58	$ 44975.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 378.	14.88	$ 5625.
N. TOTAL		948.	$ 3037.		$ 54198.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 0.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 0.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 0.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 3037.

5. SIMPLE PAYBACK PERIOD (1G/4) 25.86 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 54198.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .69
(IF < 1 PROJECT DOES NOT QUALIFY)

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	G
DATE:	6/15/95
ECO TITLE:	Replace Existing Individual Building Chillers With Central Chiller Plant
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Quadrangle Area

A. Summary:

Electrical Energy Savings	2,212	MMBTU/yr
Electrical Demand Savings	14,116	$/yr
Gas Energy Savings	0	MMBTU/yr
Total Energy Savings	2,212	MMBTU/yr
Total Cost Savings	39,257	$/yr
Total Investment	824,178	$
Simple Payback	20.9	yrs
SIR	0.71	

B. ECO Description:

Remove the seven existing air cooled, reciprocating chillers serving buildings 4015, 56, 16 and 44. Install a chilled water supply and return piping loop between the buildings in this area and terminate loop behind building 56, near the existing air cooled chiller installation. Install two new 275 ton, air cooled screw chillers in that location. Install two new 30 HP chilled water distribution pumps by new chillers to circulate water from new chillers through new distribution loop. Construct 10' high stone wall around new chiller plant to match local historical architecture. The existing chilled water pumps that serve buildings where chillers were removed will be reused to circulate chilled water from the new loop through the buildings. These existing pumps should be connected into the new distribution piping at the existing chiller locations. All new controls and electrical services should be installed at building 56 to serve the new central chillers and pumps. Other specific requirements should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing chillers and installation of the new chillers, associated wiring and controls.

C. Discussion:

The seven existing air cooled, reciprocating chillers in the Quadrangle area were installed between 1983 and 1994. They serve as the primary cooling systems for the four historically significant buildings. They generally appear to be in fair condition at this time. However, the cost of maintaining so many chillers is excessive and difficult for the maintenance staff. It is recommended that a central chiller plant, consisting of two air cooled screw machines be installed to serve all these buildings. This will not only save energy but will also reduce the maintenance costs to the installation. Computer simulations of the buildings in this area determined that the current installed capacity of 565 tons is slightly more than is required to adequately cool the buildings[1]. Therefore, it is recommended that the two new chillers be rated at a combined 550 tons to more closely match the cooling load of the buildings.

D. Savings Calculations:

1. *Energy Consumption And Savings*

The monthly peak demand and energy consumptions of the existing and proposed chillers and pumps were calculated using the Trace 600 computer program[2]. The buildings served by the existing chillers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[3].

The 275 ton air cooled screw chillers which were modeled by the computer had better part load performance ratings than reciprocating machines and were chosen for that reason. Full and part load performance data from McQuay Incorporated were used in the computer simulations of the new chiller energy usages. An equipment list of the specific chillers and pumps modeled for the new central plant are shown on page E-15.

Once the computer simulations of the existing and new chiller plants were completed, the total annual demand cost and energy consumption of the new central plant was compared with that of the existing individual systems to determine the annual savings for this ECO[4]. These savings calculations are shown on page E-16. These demand and energy savings values were used in the life cycle cost analysis.

2. *Maintenance Cost Savings*:

Maintenance cost estimates were obtained from a local maintenance contractor and were used to estimate the maintenance savings from reducing the total number of air cooled chillers in this area from seven down to two[5]. Based on an annual maintenance cost of $2,250 per chiller, the total maintenance cost savings from this ECO is estimated to be $11,250 per year. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for the new central chiller plant were estimated on page E-17. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-18. The data from the summary sheet were presented in the ECO summary on page E-13.

REFERENCES

1. See Appendix B for Quadrangle Area cooling system load profile.
2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
3. See Appendix C for building field data and existing HVAC system data.
4. See Appendix A for utility cost analysis data, used in the savings calculations.
5. See Appendix G for maintenance contractor cost estimates for air cooled chillers.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-G, FORT SAM HOUSTON, QUADRANGLE AREA

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Water Chiller	1	McQuay, electric air cooled, single screw 275 Tons, R-134a	Quadrangle Area	New	351 KW	24	7	26	607,003	
Water Chiller	1	McQuay, electric air cooled, single screw 275 Tons, R-134a	Quadrangle Area	New	351 KW	24	7	26	253,553	
Chilled Water Pump	1	660 gpm, 120 ft 30 HP	Quadrangle Area	New	22.38 KW	24	7	26	98,830	
Chilled Water Pump	1	660 gpm, 120 ft 30 HP	Quadrangle Area	New	22.38 KW	24	7	26	25,759	

QUADRANGLE AREA

ITEM	EXISTING INDIVIDUAL CHILLER PLANTS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					83.1	86.8	90.0	89.3	83.4	76.9			180,278	
Water Chiller					36.9	40.4	43.9	44.1	37.5	27.4			76,755	
Water Chiller					159.0	185.9	188.5	189.2	166.5	157.2			393,031	
Water Chiller					155.6	170.6	184.6	185.3	160.4	119.9			122,759	
Water Chiller					98.2	106.1	113.6	115.1	103.4	93.6			296,194	
Water Chiller					143.1	155.5	166.4	168.7	151.4	137.2			243,230	
Water Chiller					143.1	155.5	166.4	168.7	151.4	121.0			104,234	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			16,472	
CHW Pump					5.6	5.6	5.6	5.6	5.6	5.6			24,730	
CHW Pump					5.6	5.6	5.6	5.6	5.6	5.6			24,730	
CHW Pump					14.9	14.9	14.9	14.9	14.9	14.9			65,887	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			7,822	
CHW Pump					3.7	3.7	3.7	3.7	3.7	3.7			3,036	
Evap. Condenser					9.3	9.3	9.3	9.3	9.3	9.3			41,201	
Totals					872.9	954.7	1007.3	1014.3	907.9	787.1			1,633,303	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					6,547	9,547	10,073	10,143	9,079	5,903				

Total Demand 51,292 $/yr

Total Energy 5,574 MMBTU/yr (electric)

Total Energy MMBTU/yr (gas)

ITEM	ECO-G: NEW CENTRAL AIR COOLED SCREW CHILLERS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Water Chiller					287.6	328.3	351.0	351.0	306.5	271.9			607,003	
Water Chiller					287.6	328.3	351.0	351.0	306.5	216.4			253,553	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			98,830	
CHW Pump					22.4	22.4	22.4	22.4	22.4	22.4			25,759	
Total (KW)					620.0	701.4	746.8	746.8	657.8	533.1			985,145	
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)					4,650	7,014	7,468	7,468	6,578	3,998				

Total Demand 37,176 $/yr

Demand Savings 14,116 $/yr

Energy Savings 2,212 MMBTU/yr (electric)

Energy Savings MMBTU/yr (gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: QUAD AREA, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A./KOTHMANN,K. **CHECKED BY:** WHW

PROJECT DESCRIPTION: ECO-G, Replace Existing Individual Building Chillers With Central Chiller Plant

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Prefabricated Inulated ConduitSCH 40 Blk Stl Pipe W/ PVC Jacket				$24.64				
6"	2556	LF	1.28	$24.64	$80,614	$17.88	$45,701	$126,315
4"	500	LF	1.04	$24.64	$12,813	$15.96	$7,980	$20,793
2-1/2"	588	LF	0.94	$24.64	$13,619	$12.54	$7,374	$20,993
Chiller Yard Enclosure 40' X 40' W/ Steel Gate 10'-0" High	1	JOB		$24.64	$11,291		$38,707	$49,998
Stone Vent Wall (12" X 12" X 18") Historicly Correct								
Water Chiller Air Cooled 275 TON Single Screw w/ Pipe Assembly	2	EA	1420.00	$24.64	$69,978	$99,000.00	$198,000	$267,978
Chilled Water Pump 660 GPM X 120' 30 HP W/ Pipe Assembly	2	EA	27.50	$24.64	$1,355	$3,300.00	$6,600	$7,955
Connect to Existing Hydronic System	4	BLDG	75.00	$24.64	$7,392	$2,800.00	$11,200	$18,592
Controls / Test & Ballance	1	JOB	90.00	$24.64	$2,218	$6,500.00	$6,500	$8,718
Remove Chiller & CW pump (50 Ton) BLDG 4015	1	JOB	80.00	$24.64	$1,971	$100.00	$100	$2,071
Remove Chiller & CW pump (30 Ton) BLDG 56	1	JOB	48.00	$24.64	$1,183	$100.00	$100	$1,283
Remove Chiller & CW pump (110 Ton) BLDG 16	1	JOB	150.00	$24.64	$3,696	$200.00	$200	$3,896
Remove Chiller & CW pump (120 Ton) BLDG 16	1	JOB	150.00	$24.64	$3,696	$200.00	$200	$3,896
Remove Chiller & CW pump BLDG 44	255	TON	1.49	$24.64	$9,362	$1.50	$383	$9,745
Remove Condenser Pump Bldg 16	3	EA	6.00	$24.64	$444	$100.00	$300	$744
Electrical	1	JOB					$73,000	$73,000
				SUBTOTAL	$219,632		$396,345	$615,977
				O & P @ 20%	$43,926		$79,269	$123,195
				SUBTOTAL	$263,558		$475,614	$739,172
				DESIGN @ 6%				$44,350
				SUBTOTAL				$783,522
				SIOH @ 5.5%				$40,654
				TOTAL				$824,176

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LIFE CYCLE COST ANALYSIS SUMMARY STUDY: FSH
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID FY95 (92)
INSTALLATION & LOCATION: FSH REGION NOS. 6 CENSUS: 3
PROJECT NO. & TITLE: 03018504 EEAP BOILER CHILLER STUDY
FISCAL YEAR 96 DISCRETE PORTION NAME: ECO-G
ANALYSIS DATE: 06-16-95 ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 739172.		
B. SIOH	$ 40655.		
C. DESIGN COST	$ 44351.		
D. TOTAL COST (1A+1B+1C)	$ 824178.		
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$ 0.	
F. PUBLIC UTILITY COMPANY REBATE		$ 0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)			$ 824178.

2. ENERGY SAVINGS (+) / COST (-)
DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	2212.	$ 13891.	15.08	$ 209482.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	0.	$ 0.	18.58	$ 0.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 14116.	14.88	$ 210046.
N. TOTAL		2212.	$ 28007.		$ 419528.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 11250.
(1) DISCOUNT FACTOR (TABLE A) 14.88
(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 167400.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4) $ 167400.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE)) $ 39257.

5. SIMPLE PAYBACK PERIOD (1G/4) 20.99 YEARS

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 586928.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .71
(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	H
DATE:	6/15/95
ECO TITLE:	Replace Existing Individual Building Boilers With Central Boiler Plant
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Quadrangle Area, Building 16

A. Summary:

Electrical Energy Savings	-12	MMBTU/yr
Electrical Demand Savings	122	$/yr
Gas Energy Savings	-434	MMBTU/yr
Total Energy Savings	-446	MMBTU/yr
Total Cost Savings	5,542	$/yr
Total Investment	394,910	$
Simple Payback	71.2	yrs
SIR	0.20	

B. ECO Description:

Remove twelve existing steam boilers in building 44, which serve as the primary heating source for that building. Install a new condensate receiver, pump and buried piping to return condensate to the new central boiler plant in building 16. Provide new electrical connections as required for the new condensate pump.

Remove one 741 MBH hot water boiler from building 4015 which serves as the primary heating source for that building. Install a new 250 MBH steam to hot water generator in place of the boiler. The existing 3 HP distribution pump will remain to circulate heating water from the new generator through the building. Install a new condensate receiver, pump and buried piping to return condensate from the new generator to the new central boiler plant in building 16. Provide new electrical connections as required for the new condensate pump.

Remove one 1,614 MBH steam boiler from building 16, which serves only that building. The 3,587 MBH steam boiler in building 16 which serves it and building 56 shall remain and be used as a new central steam boiler for buildings 16, 56, 44 and 4015. Install a new condensate receiver and pump in the location where the other boiler was removed, and install new condensate return piping from there to the new central steam boiler plant in the building

Install new buried steam distribution piping from the new central steam boiler in the building out to buildings 4015, 44 and the area in building 16 where the other boiler was removed.. Connect existing steam distribution piping in buildings 44 and 16 to the new central steam distribution piping. Connect the new steam to hot water generator in building 4015 to the new central steam distribution piping.

C. Discussion:

The twelve existing steam boilers in building 44 were installed in 1970 and are rated at a combined 2,902 MBH output capacity. The single hot water boiler in building 4015 was installed in 1983, and the two steam boilers in building 16 were installed in 1979. All of these boilers appear to be in fair to poor condition. Computer simulations of the four buildings in the Quadrangle area determined that the current combined capacity of 8,970 MBH is over two times the amount required to adequately heat the buildings[1]. The existing boilers are therefore operating at an inefficient, low load condition most of the

time. By eliminating the extra boilers in the area, maintenance cost savings can be realized. Also, a decrease in the combined boiler output capacity to 3,587 MBH is recommended to more closely match the heating load in the buildings.

D. Savings Calculations:

1. *Energy Savings:*

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pump were calculated using the Trace 600 computer program[2]. The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the buildings were used to create these computer building models[3]. An equipment list with specific data on the new central boiler system used in the computer simulation is shown on page E-21.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings[4]. These savings calculations are shown on page E-22. The demand and energy savings values were used in the life cycle cost analysis for this ECO.

2. *Maintenance Savings:*

Since the total number of boilers is being reduced from fifteen down to one, there will be a substantial savings in maintenance costs. Maintenance cost estimates were obtained from a local contractor and used to estimate these savings for the installation[5]. Based on a cost annual maintenance cost of $475 per boiler, the total estimated maintenance cost savings for this ECO is $6,650. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-23. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-24. The data from the life cycle cost analysis were included in the summary on page E-19.

REFERENCES

1. See Appendix B for Quadrangle Area heating system load profile.
2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
3. See Appendix C for building field data and existing HVAC system data.
4. See Appendix A for utility cost analysis data, used in the savings calculations.
5. See Appendix G for maintenance contractor cost estimates.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-H, FORT SAM HOUSTON, QUADRANGLE AREA

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Steam Boiler	1	Rite #500 natural draft, watertube 3587 MBH output	Quadrangle Area	Exist	5,000 MBH	24	7	26		1,644
Heating Water Pump	1	N/A 3 HP	Bldg. 4015	Exist	2.24 KW	24	7	26	9,731	

QUADRANGLE AREA

ITEM	EXISTING INDIVIDUAL BOILER PLANTS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Steam Boiler														651
Steam Boiler														267
Steam Boiler														103
Steam Boiler														66
Steam Boiler														3
Firetube Boiler	3.7	3.7	3.7								3.7	3.7	4,275	120
HW Pump	2.2	2.2	2.2								2.2	2.2	1,821	
Totals	5.9	5.9	5.9								5.9	5.9	6,096	1,210
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	44	44	44								44	44		

Total Demand	221	$/yr	
Total Energy	21	MMBTU/yr	(electric)
Total Energy	1,210	MMBTU/yr	(gas)

ITEM	ECO-H: NEW CENTRAL BOILER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Steam Boiler														1,644
HW Pump	2.2	2.2	2.2	2.2							2.2	2.2	9,731	
Total (KW)	2.2	2.2	2.2	2.2							2.2	2.2	9,731	1,644
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	17	17	17	17							17	17		

Total Demand	99	$/yr	
Demand Savings	122	$/yr	
Energy Savings	-12	MMBTU/yr	(electric)
Energy Savings	-434	MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: QUAD AREA, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY : PIEPER, C.A. / KOTHMANN,K. **CHECKED BY:** WHW

PROJECT DESCRIPTION: ECO-H, Replace Existing Individual Building Boilers With Central Boiler Plant

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Condinsate Rreciever Pump Combo Unit with Pipe Assembly & Valves								
6 GPM , 60 psi , 640 lb BLDG 44	1	EA	33.00	$24.64	$813	$4,600.00	$4,600	$5,413
1.5 GPM , 30psi , 245lb / hr , BLDG 4015	1	EA	16.60	$24.64	$409	$2,700.00	$2,700	$3,109
6 GPM , 60 psi , 640 lb / hr . BLDG 16	1	EA	33.00	$24.64	$813	$4,600.00	$4,600	$5,413
Electrcal Connections & Motor Feeders	1	JOB	81.00	$24.64	$1,996	$1,800.00	$1,800	$3,796
Prefabricted Insulated Conduit sch 80 STL Carrier 2" insul. PVC Jacket								
2-1\2" with Fittings Trench & Backfill	2375	LF	0.94	$24.64	$55,009	$15.70	$37,288	$92,297
1-1\2" with Fittings Trench & Backfill	250	LF	0.84	$24.64	$5,174	$13.60	$3,400	$8,574
1" with Fittings Trench & Backfill	100	LF	0.79	$24.64	$1,947	$12.75	$1,275	$3,222
Connect to Existing Hydronic System	4	BLDG	40.00	$24.64	$3,942	$2,150.00	$8,600	$12,542
Prefabricted Insulated Conduit sch 40 STL Carrier 1" insul. PVC Jacket								
2" with Fittings Trench & Backfill	2,375	LF	0.81	$24.64	$47,401	$11.75	$27,906	$75,307
1-1\2" with Fittings Trench & Backfill	250	LF	0.78	$24.64	$4,805	$10.54	$2,635	$7,440
1" with Fittings Trench & Backfill	100	LF	0.76	$24.64	$1,873	$9.37	$937	$2,810
Reuse 3 HP Hot Water Pump Blgd 4015	1	EA	13.20	$24.64	$325	$345.00	$345	$670
Steam to Hot Water Generator , 250 MBH , bldg 4015	1	EA	15.65	$24.64	$386	$1,500.00	$1,500	$1,886
Remove Boiler & Piping	15	EA	137.00	$24.64	$50,635	$225.00	$3,375	$54,010
Controls and Test & Balance	5	BLDG	50.00	$24.64	$6,160	$2,500.00	$12,500	$18,660
				SUBTOTAL	$181,688		$113,461	$295,149
			O & P @ 20%		$36,338		$22,692	$59,030
				SUBTOTAL	$218,026		$136,153	$354,179
			DESIGN @ 6%					$21,251
				SUBTOTAL				$375,430
			SIOH @ 5.5%					$19,480
				TOTAL				$394,910

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LIFE CYCLE COST ANALYSIS SUMMARY — STUDY: FSH

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) — LCCID FY95 (92)

INSTALLATION & LOCATION: FSH   REGION NOS. 6 CENSUS: 3

PROJECT NO. & TITLE: 03018504   EEAP BOILER CHILLER STUDY

FISCAL YEAR 96   DISCRETE PORTION NAME: ECO-H

ANALYSIS DATE: 06-16-95   ECONOMIC LIFE 20 YEARS PREPARED BY: PIEPER

1. INVESTMENT

A. CONSTRUCTION COST	$ 354179.			
B. SIOH	$ 19480.			
C. DESIGN COST	$ 21251.			
D. TOTAL COST (1A+1B+1C)	$ 394910.			
E. SALVAGE VALUE OF EXISTING EQUIPMENT		$	0.	
F. PUBLIC UTILITY COMPANY REBATE		$	0.	
G. TOTAL INVESTMENT (1D - 1E - 1F)				$ 394910.

2. ENERGY SAVINGS (+) / COST (-)

DATE OF NISTIR 85-3273-X USED FOR DISCOUNT FACTORS OCT 1994

FUEL	UNIT COST $/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL $ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	$ 6.28	-12.	$ -75.	15.08	$ -1136.
B. DIST	$ .00	0.	$ 0.	18.57	$ 0.
C. RESID	$ .00	0.	$ 0.	21.02	$ 0.
D. NAT G	$ 2.66	-434.	$ -1154.	18.58	$ -21449.
E. COAL	$ .00	0.	$ 0.	16.83	$ 0.
F. PPG	$ .00	0.	$ 0.	17.38	$ 0.
M. DEMAND SAVINGS			$ 122.	14.88	$ 1815.
N. TOTAL		-446.	$ -1108.		$ -20771.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-) $ 6650.

(1) DISCOUNT FACTOR (TABLE A) 14.88

(2) DISCOUNTED SAVING/COST (3A X 3A1) $ 98952.

B. NON RECURRING SAVINGS(+) / COSTS(-)

ITEM	SAVINGS(+) COST(-) (1)	YR OC (2)	DISCNT FACTR (3)	DISCOUNTED SAVINGS(+)/ COST(-)(4)
d. TOTAL	$ 0.			0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+)/COST(-)(3A2+3Bd4)$ 98952.

4. FIRST YEAR DOLLAR SAVINGS 2N3+3A+(3Bd1/(YRS ECONOMIC LIFE))$ 5542.

5. SIMPLE PAYBACK PERIOD (1G/4) 71.26 YEAR

6. TOTAL NET DISCOUNTED SAVINGS (2N5+3C) $ 78181.

7. SAVINGS TO INVESTMENT RATIO (SIR)=(6 / 1G)= .20

(IF < 1 PROJECT DOES NOT QUALIFY)

**** Project does not qualify for ECIP funding; 4,5,6 for information only.

ENERGY CONSERVATION OPPORTUNITY (ECO)

ECO NO:	J
DATE:	6/15/95
ECO TITLE:	Replace Existing Individual Building Boilers With Central Boiler Plant
INSTALLATION:	Fort Sam Houston, San Antonio, Texas
LOCATION:	Area 100, Building 250

A. Summary:

Electrical Energy Savings	186	MMBTU/yr
Electrical Demand Savings	680	$/yr
Gas Energy Savings	680	MMBTU/yr
Total Energy Savings	866	MMBTU/yr
Total Cost Savings	11,483	$/yr
Total Investment	273,951	$
Simple Payback	23.8	yrs
SIR	0.66	

B. ECO Description:

Remove fourteen existing hot water boilers in buildings 122, 124, 128, 133, 134, 142, 143, 144, 146, 147, 149, 197, 198 and 199 which serve as the primary heating source for those buildings. Remove the two existing steam boilers in building 250. Install two new central hot water boilers rated at 563 MBH and 1250 MBH output. Locate these new boilers outside of building 250, near existing air cooled chiller installation. Install new 3 ½ inch hot water supply and return piping between the buildings in the 100 area and terminate loop at the new boiler locations behind building 250. Install new 10 HP and 15 HP heating water pumps at that location to circulate HW from the new central boilers through the new distribution loop. Reconnect individual building HW pumps to new central HW distribution piping at existing boiler locations and reuse pumps to circulate HW from loop through buildings. Provide new electrical service for new boilers as required. Other specifications in these areas should be determined by the design engineer responsible for this project. This project will require engineering drawings and specifications, demolition and removal of the existing boilers and installation of the new boilers, pumps, distribution loop, associated electrical services and controls.

C. Discussion:

The sixteen existing boilers in Area 100 were installed in 1985 and are rated at a combined 8,829 MBH output capacity. All of these boilers appear to be in fair condition. Computer simulations of the 100 Area buildings determined that the current combined capacity is nearly five times the amount required to adequately heat the buildings[1]. The existing boilers are therefore operating at an inefficient, low load condition most of the time. By eliminating the extra boilers in the area, energy and maintenance cost savings can be realized. Also, a decrease in the combined boiler output capacity to 1,813 MBH is recommended to more closely match the heating load in the buildings.

D. Savings Calculations:

1. *Energy Savings:*

The monthly peak demand and energy consumptions of the existing and proposed boilers and HW pumps were calculated using the Trace 600 computer program[2]. The buildings served by the existing boilers were modeled by the computer to provide a realistic load profile. Field data obtained from the

buildings were used to create these computer building models[3]. An equipment list with specific data on the new central boiler system used in the computer simulation is shown on page E-27.

Once the computer simulations of the existing and new boiler systems were completed, the total annual demand cost and energy consumption of the new systems were compared with that of the existing systems to determine the annual savings[4]. These savings calculations are shown on pages E-28 through E-29. The demand and energy savings values were used in the life cycle cost analysis for this ECO.

2. *Maintenance Savings:*

Since the total number of boilers is being reduced from sixteen down to two, there will be a substantial savings in maintenance costs. Maintenance cost estimates were obtained from a local contractor and used to estimate these savings for the installation[5]. Based on a cost annual maintenance cost of $475 per boiler, the total estimated maintenance cost savings for this ECO is $6,650. This figure was used in the life cycle cost analysis.

E. Cost Estimates

The total installation costs for this ECO were estimated on page E-30. These costs were used in the life cycle cost analysis.

F. Life Cycle Cost Analysis.

A life cycle cost analysis was performed on this ECO using the Life Cycle Cost In Design (LCCID) computer program, and data from the previously mentioned calculations. A summary sheet for this life cycle cost analysis is shown on page E-31. The data from the life cycle cost analysis were included in the summary on page E-25.

REFERENCES

1. See Appendix B for 100 Area heating system load profile.
2. See Appendix B for computer model input assumptions and data, and energy consumption output data.
3. See Appendix C for building field data and existing HVAC system data.
4. See Appendix A for utility cost analysis data, used in the savings calculations.
5. See Appendix G for maintenance contractor cost estimates.

PROPOSED HVAC EQUIPMENT LIST FOR: ECO-J, FORT SAM HOUSTON, AREA 100

JUNE 2, 1995

ITEM	QTY.	DESCRIPTION	AREA SERVED	YEAR INSTALLED	FULL LOAD	OPER. TIMES			ANNUAL USE	
						HRS	DAYS	WKS	KWH	MCF
Hot Water Boiler	1	Teledyne Laars natural draft, watertube 563 MBH output	Area 100	New	750 MBH	24	7	26		756
Hot Water Boiler	1	Teledyne Laars natural draft, watertube 1250 MBH output	Area 100	New	1,666 MBH	24	7	26		491
Heating Water Pump	1	57 gpm, 150 ft 10 HP	Area 100	New	7.46 KW				30,802	
Heating Water Pump	1	125 gpm, 150 ft 15 HP	Area 100	New	11.19 KW				4,454	

ITEM	EXISTING INDIVIDUAL BOILER PLANTS MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Watertube Boiler														193
Watertube Boiler														226
Watertube Boiler														82
Firetube Boiler	3.7	3.7	3.7	3.7							3.7	3.7	16,203	177
Watertube Boiler														76
Watertube Boiler														190
Watertube Boiler														112
Watertube Boiler														112
Watertube Boiler														116
Watertube Boiler														116
Watertube Boiler														89
Watertube Boiler														38
Watertube Boiler														99
Steam Boiler														172
Watertube Boiler														58
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	3,377	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,607	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,607	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,039	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	1,904	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	1,904	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	1,904	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	2,136	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	2,136	
HW Pump	0.8	0.8	0.8	0.8							0.8	0.8	1,257	
HW Pump	0.6	0.6	0.6	0.6							0.6	0.6	1,106	
HW Pump	1.1	1.1	1.1	1.1							1.1	1.1	4,865	
HW Pump	0.4	0.4	0.4	0.4							0.4	0.4	1,008	
Gas Furnace	11.3	11.3	11.3	11.3							11.3	11.3	30,002	35
Gas Furnace	0.7	0.7	0.7	0.7							0.7	0.7	3,154	36
Totals	28.2	28.2	28.2	28.2							28.2	28.2	89,804	1,927
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	212	212	212	212							212	212		

Total Demand	1,269 $/yr	
Total Energy	307 MMBTU/yr	(electric)
Total Energy	1,927 MMBTU/yr	(gas)

ITEM	ECO-J: NEW CENTRAL BOILER PLANT MONTHLY PEAK DEMAND (KW)												ANNUAL ENERGY USAGE (KWH)	ANNUAL ENERGY USAGE (MCF)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Watertube Boiler														756
Watertube Boiler														491
HW Pump	7.5	7.5	7.5	7.5							7.5	7.5	30,802	
HW Pump	11.2	11.2										11.2	4,454	
Total (KW)	18.7	18.7	7.5	7.5							7.5	18.7	35,256	1,247
Rate ($/KW)	7.50	7.50	7.50	7.50	7.50	10.00	10.00	10.00	10.00	7.50	7.50	7.50		
Cost ($)	140	140	56	56							56	140		

Total Demand	590 $/yr	
Demand Savings	680 $/yr	
Energy Savings	186 MMBTU/yr	(electric)
Energy Savings	680 MMBTU/yr	(gas)

ENGINEER'S ESTIMATE OF PROBABLE COST

LOCATION: AREA 100, FORT SAM HOUSTON

PROJECT NO: 03-0185.04 **DATE:** 6/16/95

BY: PIEPER, C.A. **CHECKED BY:** KLK

PROJECT DESCRIPTION: ECO-J, Replace Existing Individual Building Boilers With Central Boiler Plant

ITEM DESCRIPTION	QUANTITY		LABOR			MATERIAL		TOTAL COST
	# of Units	Unit Meas.	Hrs / Unit	Rate	Total	Unit Price	Total	
Prefabricated Conduit 3-1/2" Trench & backfill	2950	LF	1	$24.64	$72,688	$14	$41,300	$113,988
Remove Boilers	16	EA	40	$24.64	$15,770	$500	$8,000	$23,770
Reconnect Pump to Site Distribution	16	EA	8	$24.64	$3,154	$780	$12,480	$15,634
Install New Boiler 563 MBH	1	EA	58	$24.64	$1,429	$5,600	$5,600	$7,029
Install New Boiler 1250 MBH	1	EA	69	$25.64	$1,769	$8,500	$8,500	$10,269
Install New Pump 10 HP	1	EA	15	$24.64	$370	$1,800	$1,800	$2,170
Install New Pump 15 HP	1	EA	15	$24.64	$370	$1,900	$1,900	$2,270
pipe Assembly & valves Boiler	2	EA	28	$24.64	$1,380	$2,400	$4,800	$6,180
pipe Assembly & valves Pump	2	EA	12	$24.64	$591	$350	$700	$1,291
Boiler Breaching	1	JOB	36	$24.64	$887	$3,000	$3,000	$3,887
Controls	1	JOB	160	$24.64	$3,942	$6,900	$6,900	$10,842
Electrical	1	JOB	30	$26.64	$799	$590	$590	$1,389
Chemical Shot Feed	1	JOB	16	$26.64	$426	$1,500	$1,500	$1,926
Test, Balance & Start-up	1	LS	160	$25.64	$4,102			$4,102
				SUBTOTAL	$107,677		$97,070	$204,747
				O & P @ 20%	$21,535		$19,414	$40,949
				SUBTOTAL	$129,212		$116,484	$245,696
				DESIGN @ 6%				$14,742
				SUBTOTAL				$260,438
				SIOH @ 5.5%				$13,513
				TOTAL				$273,951

HUITT-ZOLLARS, INC.
ENGINEERS / ARCHITECTS
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FORT WORTH, TEXAS 76102-3922
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APPENDIX F

(EEAP) BOILER AND CHILLER STUDY
SCOPE OF WORK AND
REVIEW COMMENTS

CESAM-EN-DM January 1995

GENERAL SCOPE OF WORK

FOR A

LIMITED ENERGY STUDY

Performed as part of the

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

SCOPE OF WORK
FOR A
LIMITED ENERGY STUDY

TABLE OF CONTENTS

1. BRIEF DESCRIPTION OF WORK: The Architect-Engineer (AE) shall:

1.2 Perform a limited site survey of specific buildings or areas to collect all data required to evaluate the specific ECOs included in this study.

1.4 Evaluate specific ECOs to determine their energy savings potential and economic feasibility.

1.5 Provide project documentation for recommended ECOs as detailed herein.

1.6 Prepare a comprehensive report to document all work performed, the results and all recommendations.

2. GENERAL

2.1 This study is limited to the evaluation of the specific buildings, systems, or ECOs listed in Annex A, DETAILED SCOPE OF WORK.

2.2 The information and analysis outlined herein are considered to be minimum requirements for adequate performance of this study.

2.3 For the buildings, systems or ECOs listed in Annex A, all methods of energy conservation which are reasonable and practical shall be considered, including improvements of operational methods and procedures as well as the physical facilities. All energy conservation opportunities which produce energy or dollar savings shall be documented in this report. Any energy conservation opportunity considered infeasible shall also be documented in the report with reasons for elimination.

2.4 The study shall consider the use of all energy sources applicable to each building, system, or ECO.

2.5 The "Energy Conservation Investment Program (ECIP) Guidance", described in letter from DAIM-FDF-U, dated 10 Jan 1994 (including current updates) establishes criteria for ECIP projects and shall be used for performing the economic analyses of all ECOs and projects. The program, Life Cycle Cost In Design (LCCID), has been developed for performing life cycle cost calculations in accordance with ECIP guidelines and is referenced in the ECIP Guidance. If any program other than LCCID is proposed for life cycle cost analysis, it must use the mode of calculation specified

in the ECIP Guidance. The output must be in the format of the ECIP LCCA summary sheet, and it must be submitted for approval to the Contracting Officer.

2.6 Computer modeling will be used to determine the energy savings of ECOs which would replace or significantly change an existing heating, ventilating, and air-conditioning (HVAC) system. The requirement to use computer modeling applies only to heated and air-conditioned or air-conditioned-only buildings which exceed 8,000 square feet or heated-only buildings in excess of 20,000 square feet. Modeling will be done using a professionally recognized and proven computer program or programs that integrate architectural features with air-conditioning, heating, lighting and other energy-producing or consuming systems. These programs will be capable of simulating the features, systems, and thermal loads of the building under study. The program will use established weather data files and may perform calculations on a true hour-by-hour basis or may condense the weather files and the number of calculations into several "typical" days per month. The Detailed Scope of Work, Annex A, will list programs that are acceptable to the Contracting Officer. If the AE desires to use a different program, it must be submitted for approval with a sample run, an explanation of all input and output data, and a summary of program methodology and energy evaluation capabilities.

2.7 Energy conservation opportunities determined to be technically and economically feasible shall be developed into projects acceptable to installation personnel. This may involve combining similar ECOs into larger packages which will qualify for ECIP or FEMP funding, and determining in coordination with installation personnel the appropriate packaging and implementation approach for all feasible ECOs.

2.7.1 Projects which qualify for ECIP funding shall be identified, separately listed, and prioritized by the Savings to Investment Ratio (SIR).

2.7.2 All feasible non-ECIP projects shall be ranked in order of highest to lowest SIR.

2.7.3 At some installations Energy Conservation and Management (ECAM) funding will be used instead of ECIP funding. The criteria for each program is the same. The Director of Public Works will indicate which program is used at this installation. This Scope of Work mentions only ECIP, however, ECAM is also meant.

2.8 Metric Reporting Requirements: In this study, the analyses of the ECOs may be performed using English or Metric units as long as they are consistent throughout the report. The final results of energy savings for individual recommended projects and for the overall study will be reported in units of MegaBTU per year <u>and</u> in MegaWatts per year. Paragraph 7.6.2 details requirements for the contents of the final submittal.

3. PROJECT MANAGEMENT

3.1 Project Managers. The AE shall designate a project manager to serve as a point of contact and liaison for work required under this contract. Upon award of this contract, the individual shall be immediately designated in writing. The AE's designated project manager shall be approved by the Contracting Officer prior to commencement of work. This designated individual shall be responsible for coordination of work required under this contract. The Contracting Officer will designate a project manager to serve as the Government's point of contact and liaison for all work required under this contract. This individual will be the Government's representative.

3.2 Installation Assistance. The Commanding Officer or authorized representative at the installation will designate an individual to assist the AE in obtaining information and establishing contacts necessary to accomplish the work required under this contract. This individual will be the installation representative.

3.3 Public Disclosures. The AE shall make no public announcements or disclosures relative to information contained or developed in this contract, except as authorized by the Contracting Officer.

3.4 Meetings. Meetings will be scheduled whenever requested by the AE or the Contracting Officer for the resolution of questions or problems encountered in the performance of the work. The AE's project manager and the Government's representative shall be required to attend and participate in all meetings pertinent to the work required under this contract as directed by the Contracting Officer. These meetings, if necessary, will be in addition to the presentation and review conferences.

3.5 Site Visits, Inspections, and Investigations. The AE shall visit and inspect/investigate the site of the project as necessary and required during the preparation and accomplishment of the work.

3.6 Records

3.6.1 The AE shall provide a record of all significant conferences, meetings, discussions, verbal directions, telephone conversations, etc., with Government representative(s) relative to this contract in which the AE and/or designated representative(s) thereof participated. These records shall be dated and shall identify the contract number, and modification number if applicable, participating personnel, subject discussed and conclusions reached. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the records.

3.6.2 The AE shall provide a record of requests for and/or receipt of Government-furnished material, data, documents, information, etc., which if not furnished in a timely manner, would significantly impair the normal progression of the work under this

contract. The records shall be dated and shall identify the contract number and modification number, if applicable. The AE shall forward to the Contracting Officer within ten calendar days, a reproducible copy of the record of request or receipt of material.

3.7 Interviews. The AE and the Government's representative shall conduct entry and exit interviews with the Director of Public Works before starting work at the installation and after completion of the field work. The Government's representative shall schedule the interviews at least one week in advance.

3.7.1 Entry. The entry interview shall describe the intended procedures for the survey and shall be conducted prior to commencing work at the facility. As a minimum, the interview shall cover the following points:

a. Schedules.

b. Names of energy analysts who will be conducting the site survey.

c. Proposed working hours.

d. Support requirements from the Director of Public Works.

3.7.2 Exit. The exit interview shall be held when the field work is essentially complete; it shall briefly describe the items surveyed and probable areas of energy conservation. The interview shall also solicit input and advice from the Director of Public Works.

4. SERVICES AND MATERIALS. All services, materials (except those specifically enumerated to be furnished by the Government), labor, supervision, and travel necessary to perform the work and render the data required under this contract are included in the lump sum price of the contract.

5. PROJECT DOCUMENTATION. All energy conservation opportunities which the AE has considered shall be included in one of the following categories and presented in the report as such:

5.1 ECIP Projects. To qualify as an ECIP project, an ECO, or several ECOs which have been combined, must have a construction cost estimate greater than $300,000, a Savings to Investment Ratio (SIR) greater than 1.25 and a simple payback period of less than ten years. The overall project and each discrete part of the project shall have an SIR greater than 1.25. All projects meeting the above criteria shall be arranged as specified in paragraph 2.7.1 and shall be provided with programming documentation. Programming documentation shall consist of a DD Form 1391 and life cycle cost analysis (LCCA) summary sheet(s) (with necessary backup data to verify the numbers presented). A life cycle cost analysis summary sheet shall be developed for each ECO and for the overall project when more than one ECO are combined. The energy savings for projects consisting of multiple ECOs must take into account

the synergistic effects of the individual ECOs.

5.2 Non-ECIP Projects. Projects which do not meet ECIP criteria with regard to cost estimate, but which have an SIR greater than 1.25 shall be documented. Projects or ECOs in this category shall be arranged as specified in paragraph 2.7.2 and shall be provided with the following documentation: the life cycle cost analysis (LCCA) summary sheet completely filled out, a description of the work to be accomplished, backup data for the LCCA (energy savings calculations and cost estimate), and the simple payback period. The energy savings for projects consisting of multiple ECOs must take into account the synergistic effects of the individual ECOs. In addition these projects shall have the necessary documentation prepared, as required by the Government's representative, for one of the following categories:

a. Federal Energy Management Program (FEMP) Projects. A FEMP (or O&M Energy) project is one that results in needed maintenance or repair to an existing facility, or replaces a failed or failing existing facility, and also results in energy savings. The criteria are similar to the criteria for ECIP projects, ie, SIR $\geq$ 1.25, and simple payback period of less than ten years. Projects with a construction cost estimate up to $1,000,000 shall be documented as outlined in par 5.2 above; projects over $1,000,000 shall be documented on 1391s. In the FEMP program, a system may be defined as "failed or failing" if it is inefficient or technically obsolete. However, if this strategy is used to justify a proposed project, the equipment to be replaced must have been in use for at least three years.

b. Low Cost/No Cost Projects. These are projects which the Director of Public Works (DPW) can perform using his resources. Documentation shall be as required by the DPW.

5.3 Nonfeasible ECOs. All ECOs which the AE has considered but which are not feasible, shall be documented in the report with reasons and justifications showing why they were rejected.

6. DETAILED SCOPE OF WORK. The Detailed Scope of Work is contained in Annex A.

7. WORK TO BE ACCOMPLISHED.

7.2 Perform a Limited Site Survey. The AE shall obtain all necessary data to evaluate the ECOs or projects by conducting a site survey. However, the AE is encouraged to use any data that may have been documented in a previous study. The AE shall document his site survey on forms developed for the survey, or on

standard forms, and submit these completed forms as part of the report. All test and/or measurement equipment shall be properly calibrated prior to its use.

7.4 Evaluate Selected ECOs. The AE shall analyze the ECOs listed in Annex A. These ECOs shall be analyzed in detail to determine their feasibility. Savings to Investment Ratios (SIRs) shall be determined using current ECIP guidance. The AE shall provide all data and calculations needed to support the recommended ECO. All assumptions and engineering equations shall be clearly stated. Calculations shall be prepared showing how all numbers in the ECO were figured. Calculations shall be an orderly step-by-step progression from the first assumption to the final number. Descriptions of the products, manufacturers catalog cuts, pertinent drawings and sketches shall also be included. A life cycle cost analysis summary sheet shall be prepared for each ECO and included as part of the supporting data.

7.5 Combine ECOs Into Recommended Projects. During the Interim Review Conference, as outlined in paragraph [7.6.1], the AE will be advised of the DEH's preferred packaging of recommended ECOs into projects for implementation. Some projects may be a combination of several ECOs, and others may contain only one. These projects will be evaluated and arranged as outlined in paragraphs 5.1, 5.2, and 5.3. Energy savings calculations shall take into account the synergistic effects of multiple ECOs within a project and the effects of one project upon another. The results of this effort will be reported in the Final Submittal per par [7.6.2].

7.6 Submittals, Presentations and Reviews. The work accomplished shall be fully documented by a comprehensive report. The report shall have a table of contents and shall be indexed. Tabs and dividers shall clearly and distinctly divide sections,

subsections, and appendices. All pages shall be numbered. Names of the persons primarily responsible for the project shall be included. The AE shall give a formal presentation of the interim submittal to installation, command, and other Government personnel. Slides or view graphs showing the results of the study to date shall be used during the presentation. During the presentation, the personnel in attendance shall be given ample opportunity to ask questions and discuss any changes deemed necessary to the study. A review conference will be conducted the same day, following the presentation. Each comment presented at the review conference will be discussed and resolved or action items assigned. It is anticipated that the presentation and review conference will require approximately one working day. The presentation and review conference will be at the installation on the date agreeable to the Director of Public Works, the AE and the Government's representative. The Contracting Officer may require a resubmittal of any document(s), if such document(s) are not approved because they are determined by the Contracting Officer to be inadequate for the intended purpose.

7.6.1 Interim Submittal. An interim report shall be submitted for review after the field survey has been completed and an analysis has been performed on all of the ECOs. The report shall indicate the work which has been accomplished to date, illustrate the methods and justifications of the approaches taken and contain a plan of the work remaining to complete the study. Calculations showing energy and dollar savings, SIR, and simple payback period of all the ECOs shall be included. The results of the ECO analyses shall be summarized by lists as follows:

a.All ECOs eliminated from consideration shall be grouped into one listing with reasons for their elimination as discussed in par 5.3.

b.All ECOs which were analyzed shall be grouped into two listings, recommended and non-recommended, each arranged in order of descending SIR. These lists may be subdivided by building or area as appropriate for the study.

The AE shall submit the Scope of Work and any modifications to the Scope of Work as an appendix to the report. A narrative summary describing the work and results to date shall be a part of this submittal. At the Interim Submittal and Review Conference, the Government's and AE's representatives shall coordinate with the Director of Public Works to provide the AE with direction for packaging or combining ECOs for programming purposes and also indicate the fiscal year for which the programming or implementation documentation shall be prepared. The survey forms completed during this audit shall be submitted with this report. The survey forms only may be submitted in final form with this submittal. They should be clearly marked at the time of submission that they are to be retained. They shall be bound in a standard three-ring binder which will allow repeated disassembly and reassembly of the material contained within.

7.6.2 Final Submittal. The AE shall prepare and submit the final report when all sections of the report are 100% complete and all comments from the interim submittal have been resolved. The AE shall submit the Scope of Work for the study and any modifications to the Scope of Work as an appendix to the submittal. The report shall contain a narrative summary of conclusions and recommendations, together with all raw and supporting data, methods used, and sources of information. The report shall integrate all aspects of the study. The recommended projects, as determined in accordance with paragraph 5, shall be presented in order of priority by SIR. The lists of ECOs specified in paragraph [7.6.1] shall also be included for continuity. The final report and all appendices shall be bound in standard three-ring binders which will allow repeated disassembly and reassembly. The final report shall be arranged to include:

a. An Executive Summary to give a brief overview of what was accomplished and the results of this study using graphs, tables and charts as much as possible (See Annex B for minimum requirements).

b. The narrative report describing the problem to be studied, the approach to be used, and the results of this study.

c. Documentation for the recommended projects (includes LCCA Summary Sheets).

d. Appendices to include as a minimum:

1) Energy cost development and backup data

2) Detailed calculations

3) Cost estimates

4) Computer printouts (where applicable)

5) Scope of Work

ANNEX A

DETAILED SCOPE OF WORK
CONTRACT NO. DACAC63-94-D-0015
DELIVERY ORDER NO. 000

1. The Architect-Engineer (A-E) shall furnish all services, material, supplies, plant, labor, equipment, investigations, studies, superintendence and travel as required in connection with the below identified project for design in accordance with the original basic contract and this Detailed Scope of Work. Appendix "A" of the basic contract shall be followed for performance requirements for A-E services. Where this Detailed Scope of Work conflicts with Appendix "A", this Detailed Scope of Work shall govern.

INSTALLATION	PROJECT TITLE
Fort Sam Houston, TX	Boiler/Chiller Study (EEAP)

2. The work and other related data and services required in this Delivery Order shall be accomplished within the time schedule required, in accordance with the subject stated above and scope of work described in paragraph 3 below. The schedule for delivery of data to the Contracting Officer is in calendar days as follows:

	DELIVERY SCHEDULE
a. Interim Submittal and related data for studies (See Annex B for number of copies)	60 calendar days after receipt of Delivery Order
b. Pre-Final Submittal(s)	90 calendar days after approval of Interim submittal
c. Final Submittal (original and all data developed under this submittal)	90 calendar days after approval of the pre-final

3. The items of work included in this Delivery Order shall be in accordance with criteria furnished at the Scoping conference held 29 June 1994 at Fort Sam Houston. The services to be provided shall include, but not be limited to, the following Scope of Work.

a. Items of Work:

(1) 2200 Area. Evaluate the feasibility and economic impacts of modifying the existing cooling and heating plant in Building 2265. This plant provides heating hot water and chilled water to Buildings 2263, 2264, 2265 and 2266. The feasibility study will consider chiller replacement or retrofit and boiler

upgrade or replacement. A limited survey of the four existing buildings served by this plant will be performed to permit a qualitative verification that the existing plant capacities are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Chiller replacement/retrofit recommendations will consider refrigerants 123 or 134a only, gas vs. electrical driven compressors, drive configuration (i.e., open-drive vs. hermetic), operating efficiency (i.e., compressor type: screw vs. centrifugal part load and full load capacities and variable speed drive) and maintainability. The cost effects of the new design criteria from the Uniform Mechanical code which requires a partition be provided between the chiller and boiler shall be investigated. As the thermal load history for the plant is not available, a generalized load profile will be assumed and used to analyze the benefits of energy saving options and equipment selections. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

(2) 2200 Area (item 1 must be performed in conjunction with this item). Evaluate buildings 2263, 2264, 2265, and 2266 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each.

(3) 2200 Area (items 1 or 1a must be performed in conjunction with this item). Evaluate the use of four-pipe heating and cooling distribution from the central plant. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment. Based on the current type of building occupancy, a determination will be provided on whether a single mode of plant operation will suit the air conditioning requirements for the group of buildings tied into the plant, as will occur in a two pipe system. Also, considering the constant changing use of the Army facilities, the firm performing the study shall provide their own engineering judgement on whether locking a facility into a particular type of occupancy (i.e., loss of flexibility) makes sense, as will also occur in a two pipe system. The fact that a complete system shut down is needed in order to perform maintenance in a two pipe system, will be addressed in the engineering judgement decision.

(4) 1300 Area. Evaluate the feasibility and economic impacts of modifying the existing cooling and heating plant in Building 1377. This plant provides heating hot water and chilled water to Buildings 1350, 1374, 1375, 1379, 1380, 1382, and 1385. The feasibility study will consider chiller replacement or retrofit and boiler upgrade or replacement. A limited survey of the seven existing buildings served by this plant will be performed to permit a qualitative verification that the existing plant capacities are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Chiller replacement/retrofit recommendations will consider refrigerants 123 or 134a only, gas vs. electrical driven compressors, drive configuration (i.e., open-drive vs. hermetic), operating efficiency (i.e, compressor type: screw vs. centrifugal part load and full load capacities and variable speed drive) and maintainability. The cost effects of the new design criteria from the Uniform Mechanical code which requires a partition be provided between the chiller and boiler shall be investigated. As the thermal load history for the plant is not available, a generalized load profile will be assumed and used to analyze the benefits of energy saving options and equipment selections. recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

(5) 1300 Area (item 2 must be performed in conjunction with this item). Evaluate Buildings 1350, 1374, 1375, 1379, 1380, 1382 and 1385 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each. Evaluate the optimum size and configuration for the central plant.

(6) 900 Area. Evaluate the feasibility and economic impacts of modifying the existing cooling and heating plant in Building 902. This plant provides heating hot water and chilled water to Buildings 902, 904, 905, 906, 907, 908, 916, 917, 919, 920, 921, 922, 924, 925, 926, 928, 929, 930, and 931. The feasibility study will consider chiller replacement or retrofit or refrigerant upgrade and boiler upgrade or modification or replacement. A limited survey of the nineteen existing buildings served by this plant will be performed to permit a qualitative verification that the existing plant capacities are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Chiller replacement/retrofit recommendations will consider refrigerants 123 or 134a only, gas vs. electrical

driven compressors, drive configuration (i.e., open-drive vs. hermetic), operating efficiency (i.e., compressor type: screw vs. centrifugal part load and full load capacities and variable speed drive) and maintainability. The cost effects of the new design criteria from the Uniform Mechanical code which requires a partition be provided between the chiller and boiler shall be investigated. As the thermal load history for the plant is not available, a generalized load profile will be assumed and used to analyze the benefits of energy saving options and equipment selections. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

(7) 900 Area (item 3 must be performed in conjunction with this item. Evaluate Buildings 902, 904, 905, 906, 907, 908, 916, 917, 919, 920, 921, 922, 924, 925, 926, 928, 929, 930, and 931 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each. Evaluate the optimum size and configuration for the central plant.

(8) 100 Area. Review the existing design manual and construction documents prepared in 1986 to provide a central plant at building 250 to serve Buildings 122, 124, 125, 127, 128, 132, 133, 134, 135, 142, 143, 144, 145, 146, 147, 149, 197, 198, 199, and 250. A limited survey of the twenty existing buildings served by this plant will be performed to permit a qualitative verification that the plant capacities established in 1986 are adequate. The survey will also reveal constraining requirements such as year-round cooling requirements which may influence the recommendations. Make recommendations to modify the equipment selections developed with that design and develop a conceptual cost estimate for its implementation. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

(9) 100 Area (item 4 must be performed in conjunction with this item). Evaluate Buildings 122, 124, 125, 127, 128, 132, 133, 134, 135, 142, 143, 144, 145, 146, 147, 149, 197, 198, 199, and 250 and model each building to develop a probable annual thermal load profile. Receive as-built drawings on the buildings from Fort Sam Houston and perform a survey of the buildings to collect information necessary to more accurately develop the annual thermal profile of each. Evaluate the optimum size and configuration for the central plant.

(10) Quadrangle. Evaluate the feasibility and economic impacts of providing a new cooling and heating plant adjacent to the Quadrangle. This plant would provide heating hot water and chilled water to buildings 16, 44, T-56, and 4015. Receive as-built drawings on the buildings from Fort Sam Houston and model each building to develop a probable annual thermal load profile. Evaluate the optimum size and configuration for the central plant. Develop recommendations for a central plant configuration and location which will complement the historic nature of the Quadrangle. Evaluate the use of 2-pipe versus 4-pipe thermal distribution. Recommendations will be supported by life cycle cost analyses which will include initial purchase and installation costs, energy consumption costs, and maintenance costs extended over the useful life of the equipment.

c. Special Requirements: Distribution of submittal documents are as follows:

(1) Three copies of all documents shall be mailed to:

Commander
U.S. Army Engineer District, Fort Worth
819 Taylor Street/P.O. Box 17300
ATTN: CESWF-ED-MR/Champagne
Fort Worth, Texas 76102-0300

(2) Ten copies of all documents, field survey data and one disk shall be mailed to:

Commander
ATTN: AFZG-PW-ESB/Mr. De La Pena
Department of Army
HQ, Fort Sam Houston
Fort Sam Houston, TX 78234

ANNEX B

EXECUTIVE SUMMARY GUIDELINE

1. Introduction.

2. Building Data (types, number of similar buildings, sizes, etc.)

3. Present Energy Consumption of Buildings or Systems Studied.

   o Total Annual Energy Used.

   o Source Energy Consumption.

Electricity	- KWH, Dollars, BTU
Fuel Oil	- GALS, Dollars, BTU, MWH
Natural Gas	- THERMS, Dollars, BTU, MWH
Propane	- GALS, Dollars, BTU, MWH
Other	- QTY, Dollars, BTU, MWH

4. Reevaluated Projects Results.

5. Energy Conservation Analysis.

   o ECOs Investigated.

   o ECOs Recommended.

   o ECOs Rejected. (Provide economics or reasons)

   o ECIP Projects Developed. (Provide list)*

   o Non-ECIP Projects Developed. (Provide list)*

   o Operational or Policy Change Recommendations.

   * Include the following data from the life cycle cost analysis summary sheet: the cost (construction plus SIOH), the annual energy savings (type and amount), the annual dollar savings, the SIR, the simple payback period and the analysis date.

6. Energy and Cost Savings.

   o Total Potential Energy and Cost Savings.

   o Percentage of Energy Conserved.

   o Energy Use and Cost Before and After the Energy Conservation Opportunities are Implemented.

ANNEX C

REQUIRED DD FORM 1391 DATA

To facilitate ECIP project approval, the following supplemental data shall be provided:

a. In title block clearly identify projects as "ECIP."

b. Complete description of each item of work to be accomplished including quantity, square footage, etc.

c. A comprehensive list of buildings, zones, or areas including building numbers, square foot floor ajects.

(11) Latest MCP Index, essential for projecting costs for project documentation.

(12) The following items are important and should be provided to the AE to the extent to which they are available:

(a) As-built drawings of applicable buildings, equipment, or systems

(b) Handbooks or SOPs relating to the operation of applicable equipment or systems.

(c) Applicable records of energy or fuel usage.

(d) Copies of bills for electrical enetration assumptions before and after improvements.

(4) Include source of expertise and demonstrate savings claimed. Identify any special or critical environmental conditions such as pressure relationships, exhaust or outside air quantities, temperatures, humidity, etc.

e. Claims for boiler efficiency improvements must identify data to support present properly adjusted boiler operation and future expected efficiency. If full replacement of boilers is indicated, explain rejection of alternatives such as replace burners, nonfunctioning controls, etc. Assessment of the complete existing installation is required to make accurate determinations of required retrofit actions.

f. Lighting retrofit projects must identify number and type of fixtures, and wattage of each fixture being deleted and installed. New lighting shall be only of the level to meet current criteria. Lamp changes in existing fixtures is not considered an ECIP type project.

g. An ECIP life cycle cost analysis summary sheet as shown in the ECIP Guidance shall be provided for the complete project and for each discrete part included in the project. The SIR is applicable to all segments of the project. Supporting documentation consisting of basic engineering and economic calculations showing how savings were determined shall be included.

h. The DD Form 1391 face sheet shall include, for the complete project, the annual dollar and MBTU savings, SIR, simple amortization period and a statement attesting that all buildings and retrofit actions will be in active use throughout the amortization period.

i. The calendar year in which the cost was calculated shall be clearly shown on the DD Form 1391.

j. For each temporary building included in a project, separate documentation is required showing (1) a minimum 10-year continuing need, based on the installation's annual real property utilization survey, for active building retention after retrofit, (2) the specific retrofit action applicable and (3) an economic analysis supporting the specific retrofit.

k. Nonappropriated funded facilities will not be included in an ECIP project without an accompanying statement certifying that utility costs are not reimbursable.

l. Any requirements required by ECIP guidance dated 10 Jan 1994 and any revisions thereto. Note that unescalated costs/savings are to be used in the economic analyses.

m. The five digit category number for all ECIP projects except for Family Housing is 80000. The category code number for Family Housing projects is 71100.

INTERIM SUBMITTAL REVIEW COMMENTS - HQ FORSCOM

7/6/95

REVIEW COMMENTS FOR INTERIM SUBMITTAL :
EEAP CHILLER AND BOILER PLANT STUDY AT FORT SAM HOUSTON, TX

REVIEWER: NARESH K.KAPUR, P.E. DATED: 6 JULY 95
ORGANIZATION: HQ FORSCOM
ADDARESS: ATTN: AFPI-ENO/KAPUR TEL: 404-669-5327, FAX 7751
BLDG 200,
FORT MCPHERSON, GA 30330-6000

1.THE INTERIM REPORT IS WELL ORGANIZED. IT WOULD BE NICE TO HAVE ONE OR TWO PAGE WRITEUP TO PROVIDE A GIST OF THIS STUDY. SOME OF THE ITEMS TO BE ADDRESSED IN THIS ARE: PURPOSE & SCOPE: ALTERNATIVES CONSIDERED; METHODS OF ANALYSIS AND ASSUMPTIONS; RECOMMENDED ECOs AND THEIR LCC INFO.

2. GENERAL. FOR MANY BUILDINGS, LACK OF HVAC CONTROLS LEAD TO OCCUPIED AREAS VERY HOT. REQUEST PROVIDE A SUGGESTED SOLUTION BASED ON YOUR FIELD OBSERVATIONS.

3. GENERAL. DISCUSS VARIOUS OPTIONS FOR SELECTING CHILLERS AND BOILERS FOR ECOs. MENTION PROS AND CONS OF EACH, INCLUDING COST FACTORS, ENERGY EFFICIENCIES, POSSIBLE CHILLER WITH INTEGRAL HEATING UNIT, AND EASE OF MAINTENANCE ETC.

4. GENERAL. FROM ENVIRONMENTAL CONSIDERATIONS, IT IS DESIRABLE TO AVOID OZONE DEPLETING CHEMICALS (ODC) TYPE REFRIGERENTS FOR NEW CHILLERS. NATURAL GAS ABSORPTION CHILLERS (SEE ENCLOSED INFO) ARE AVAILABLE IN MANY VARIETIES AND USE NON-ODC REFRIGERENT. PL DISCUSS POSSIBILITIES. BY USING NON-ODC REFRIGERENT IN NEW CHILLERS WE CAN POSSIBLY HAVE RECURRING SAVINGS DUE TO SOME AVOIDED MAINTENANCE COST.

5. GENERAL. PER YOUR SITE VISIT OBSERVATIONS, MOST OF THE AREAS WERE EXCESSIVELY WARM AND HVAC CONTROLS POOR. HOW DOES THIS AFFECT THE LCC ANALYSIS?

6. PG 6. PROVIDE A RECOMMENDED ACTION PLAN TO ADEQUATELY MAINTAIN HVAC SYSTEMS IN VIEW OF EVER DIMINISHING MAINTENANCE PERSONNEL WHO ARE NOT WELL TRAINED.

7. GENERAL. IN A CENTRAL PLANT SITUATION, THERE ARE TRANSMISSION LOSSES AND OTHER INHERENT INEFFICIENCIES WHEN THE OCCUPANCY OF BUILDINGS IS NOT UNIFORM. CONSIDER DOING A SAMPLE LCC ANALYSIS CONSIDERING SELECTIVE DECENTRALIZING HEATING AND COOLING EQUIPMENT. IN SMALLER UNITS, WE EXPECT EASIER CONTROLS/ MAINTENANCE. SMALLER UNITS CAN BE SHUTDOWN DURING WEEKENDS/ HOLIDAYS AND NON-WORKING HOURS.

8. GENERAL. PL ADDRESS THE FOLLOWINGS:

A. WHAT ARE DOMESTIC HOT WATER REQUIREMENTS DURING HEATING AND COOLING SEASON? HOW ARE THESE REQUIREMENTS CURRENLY MET? ADDRESS THIS ISSUE IN EACH ALTERNATIVE AS APPROPRIATE.

B. ARE THERE SIGNIFICANT ENERGY REQUIREMENTS RELATED TO COOKING? PL DISCUSS.

C. ANY SIGNIFICANT COOLING LOADS DURING HEATING SEASON/ PL DISCUSS.

D. PL DISCUSS 4 PIPE V/S 2PIPE SYSTEM AS RELATED TO FT SAM HOUSTON SITUATION.

INTERIM SUBMITTAL REVIEW COMMENTS - USAED MOBILE

7/6/95

P.3-3

MOBILE DIST. OFFICE PROJECT REVIEW COMMENTS	DATE: 6 July 95	PAGE 1 of 1
TO: Army Corps of Engineers Fort Worth Division	FROM: (Section): EN-DM (Reviewer): Robert S. Woodruff	
PROJECT: Boiler and Chiller Study LOCATION: Fort Sam Houston	Year:	Line Item No.:

Type of Action: Interim Report

Item No.	Drawing No. Or Par. No.	COMMENTS	Review Action
1.	Page i	The first sentence of the third paragraph should be reworded.	
2.	Page 2 Para. B.1.	Buildings 915 and 932 should be added to the list of of 900 area buildings studied. The actual study data indicates that these two building were studied (see page C-2).	
3.	Page 2 Para. B.2.	Building 1377 should be added to the list of 1300 area buildings. This building was part of the actual study (see page C-11).	
4.	Page 5 Para. 1	The type of refrigerant used in each of the chillers serving the quadrangle buildings should be listed.	
5.	General	The operating schedules used in the Trace studies appear to be reasonable. It should be pointed out in the study report that if the existing controls were repaired and set properly the energy savings would be even greater than those predicted by the study.	
6.	General	The replacement chiller for the 1300 area appears very close to meeting the criteria for approval. Are there any ways that this ECO could be modified to make it feasible?	

INTERIM SUBMITTAL REVIEW COMMENTS - FORT SAM HOUSTON, TX
7/10/95

ENGINEERING REVIEW COMMENTS

ACTIVITY: AFZG-PW-ESB

DATE: 7/10/95

TYPE OF REVIEW: [ ] PRELIMINARY [X] FINAL

AREA OF REVIEW: 1. [ ] CIVIL 2. [ ] ARCHITECTURAL 3. [ ] STRUCTURAL 4. [X] MECHANICAL 5. [ ] ELECTRICAL 6. [ ] OTHER

PROJECT: Boiler/Chiller Common Plant Study

ITEM NUMBER:

PREPARED BY: F. CARBONELL

LEGEND: A - Concur D - Do not concur E - Exception, see comment X - Delete comment

DRAWING NO. OR PAR. NO.	COMMENT NO.	COMMENT (TYPE OR PRINT)	ACTION BY REVIEW AGENCIES
3, 4, 5	1.	DO NOT CONSIDER REDUCING CAPACITIES SINCE EXISTING CAPACITIES WERE FOUND TO BE MORE THAN WHAT IS NEEDED IN MOST ~~ALL~~ CASES.	
5	2	A CENTRAL PLANT FOR THE QUADRANGLE AREA WOULD REQUIRE MUCH MORE THAN A "HISTORICALLY CORRECT" WALL TO HIDE EQUIPMENT. THE CENTRAL PLANT WOULD EITHER HAVE TO BE UNDERGROUND OR IN ONE OF THE EXISTING BUILDINGS SURROUNDING THE QUADRANGLE. THIS WOULD REQUIRE VERY	

ESH Form 847* THOROUGH AND ...

INTERIM SUBMITTAL REVIEW COMMENTS - FORT SAM HOUSTON, TX
7/10/95

ENGINEERING REVIEW COMMENTS

ACTIVITY: AFZG-PW-ESB

DATE: 7/10/95

TYPE OF REVIEW: ☐ PRELIMINARY ☐ FINAL

AREA OF REVIEW: 1. ☐ CIVIL 2. ☐ ARCHITECTURAL 3. ☐ STRUCTURAL 4. ☒ MECHANICAL 5. ☐ ELECTRICAL 6. ☐ OTHER

PROJECT: Boiler Chiller Central Plant Study

ITEM NUMBER:

PREPARED BY: F. Carbonell

LEGEND: A - Concur O - Do not concur E - Exception, see comment X - Delete comment

DRAWING NO. OR PAR. NO.	COMMENT NO.	COMMENT (TYPE OR PRINT)	ACTION BY REVIEW AGENCIES			
6	3	Replace the words ~~the~~ "appears to be" in the second line and in the eighth line of paragraph "Maintenance data" with the word "is"				

ESH FORM 847

AUG 02 '95 15:34 No.008 P.04 ID:2102215805

RESPONSES TO INTERIM SUBMITTAL REVIEW COMMENTS

7/10/95

A. FORSCOM Comments:

1. Executive summary in final report will summarize the study as requested.

2. Additional maintenance recommendations will be added to study which will address the repair of HVAC controls in the buildings.

3. Additional text will be added which will describe the selection of new equipment to be used in the analysis in this study.

4. Gas absorption cooling systems would eliminate the concerns over refrigerant types to be used in the new chillers. However, analysis of these types of cooling systems is beyond the scope of this study. (See pages F-11 through F-15)

5. An underlying assumption in all ECOs in this study is that the building controls remain as-is, and the new central cooling and heating systems merely save central plant heating and cooling energy, rather than improve building temperature control. Therefore, the LCC analysis of each ECO is valid whether the building HVAC controls are repaired or not. However, it is acknowledged that additional energy savings are possible if these controls are repaired. But analysis of these savings is beyond the scope of this study. (See pages F-11 through F-15)

6. An underlying assumption in the maintenance and operations recommendations made in this study is that the installation has adequate resources to implement them. It is beyond the scope of this study to determine the installations maintenance capabilities and provide maintenance strategies based on them.

7. Because of the apparent shortage of HVAC maintenance manpower at this installation, it is felt that centralization of the primary heating and cooling equipment is the best strategy to pursue. Consideration of unitized primary heating and cooling equipment is beyond the scope of this study. (See pages F-11 through F-15)

8(A). Descriptions of all domestic hot water heating systems can be found in the building data sheets in Appendix C. All DHW systems, except for the 900 area, are unitized by building, and separate from the heating system. It is assumed that DHW demand is directly related to building occupancy rather than outside weather conditions. In area 900, the DHW demand used in the study was taken from a 12 month metered gas profile for building 902. This amounted to boiler base load of 565 BTUH, as described on page B-3, item E (5). This load was constant throughout the year, due to the nearly constant occupancy of the barracks buildings in the 900 area.

8(B). Only buildings 1377 and 2265 have small boilers which are used for cooking loads. These cooking energy demands were assumed to be small as compared to the heating and cooling demands of all buildings in the study. Therefore, any ECO performed on these cooking boilers would have very long paybacks of greater than 10 years.

8(C). Because of the physical size of the buildings studied, and the types of internal heat sources present within them, the only significant cooling loads possible during the heating season would be in areas which house central computer equipment. The areas which fit this description were

generally served by unitary cooling equipment which could operate independently of the central HVAC systems, therefore providing cooling during the heating season if required. Building 2263 however has large computer areas without unitized cooling systems. In almost all cases, the analyst feels that the lack of operable HVAC controls along with the apparent over sizing of the central boiler systems is the cause of the high temperatures within the buildings during the heating season. However, operable windows are available in many cases to offset the lack of temperature controls.

8(D). The evaluation of two-pipe vs. Four-pipe systems at the installation was determined by the contracting officer to be beyond the scope of this study. Therefore, it was omitted.

B. MOBILE

1. Sentence reworded as requested.

2. Buildings added to list as requested.

3. Building added to list as requested.

4. Refrigeration types added to description as requested.

5. Statement added to Maintenance & Operations Recommendations as requested.

6. The area 1300 chiller replacement (ECO-C) was reevaluated, leaving the 1983 chiller in place and only replacing the two 1972 chillers with a single new chiller. The new payback is 8.4 years and this ECO is now recommended.

C. FORT SAM HOUSTON

1. Over sizing of the new boiler and chiller equipment in the study would cause the ECO paybacks to be over 10 years and therefore unacceptable. Therefore, new equipment was sized to closely match the heating and cooling load profiles given in Appendix B.

2. ECO-G, the central chiller plant for the Quadrangle area, was evaluated to have a 20.9 year payback and was therefore not recommended for implementation. Increasing the implementation cost of this ECO by adding funds for architectural aesthetics would not improve the payback time. Therefore, no changes were made to this ECO.

3. Words replaced as requested.

APPENDIX G

SAMPLE PRODUCTS

APPENDIX G
SAMPLE PRODUCTS

TABLE OF CONTENTS

DYNASERVICE

RECEIVED
MAR 01 1995
HZ

FEBRUARY 27, 1995

MR. WALTER WILLIAMS, III P.E.
HUITT-ZOLLARS, INC.
512 MAIN STREET SUIT 1500
FORT WORTH, TX 76102

A DIVISION OF
DYNA TEN
CORPORATION
7466 Dogwood Par-
Fort Worth
Texas 76118
817.595.4433
Metro
817.589 9911
FAX
817.589 0200

Walter,

I have projected maintenance cost for equipment you have noted broken down to per unit per visit on AHU, FCU, Fans, etc. Recommended at four (4) visits per year normal conditions. Severe conditions may require more frequent visits. To obtain heating and cooling season costs just divide visits in half and omit items such as water heater and exhaust fans if you do not want them included in heating and cooling costs.

NOTES: Boilers: one (1) visit per year annual inspection
Chillers: four (4) visits per year. Three (3) routine checks and one (1) annual winter service.
GeoTherm Wells: not applicable
Cooling Towers: one (1) visit per year complete annual clean and service

*Annual switch from heat to cool is per season per building.

Attached list shows breakdown of costs. If you have any questions, please call.

Sincerely,

David J. Recca

David J. Recca
Customer Relations &
Sales

DR/als huitt

DYNASERVICE

PAGE FOUR OF FIVE
HUITT ZOLLARS
PAGE THREE OF BREAKDOWN
PREVENTIVE MAINTENANCE

B. CENTRAL PLANT EQUIPMENT

1. Cooling Equipment

All of the below alternatives include a new chilled water pump (25 hp) and cooling tower.

a. Existing Chiller retrofit to R-123 refrigerant, includes checking room sensors*	$2275/yr
b. New Water Cooled Centrifugal Chiller R-22*	$2275/yr
c. New Water Cooled Centrifugal Chiller R-123*	$2275/yr
d. New Water Cooled Centrifugal Chiller R-134A*	$2275/yr
e. New Water Cooled Screw Chiller*	$2275/yr
f. New Water Cooled Centrifugal Chiller with VFD Compressor motor and inlet vanes*	$2275/yr
g. New Engine Driven Chiller - Natural Gas fired combustion engine. Similar to York CAT engine drive chiller. Jacket water will be utilized to heat domestic hot water during the summer months*	$3075/yr

*Oil test only, no oil change

All of the below alternatives include a new chilled water pump (25 hp)

a. New air cooled reciprocating chiller*	$2250/yr
b. New air cooled screw chiller*	$2250/yr
c. Chilled Water Pump (25 hp)	$25**

*Assume 300 ton size equipment
**per visit

2. Heating Equipment

All of the below alternatives include a new heating water pump (20 hp)

a. New standard firetube boilers	2	$475*
b. New vertical fired high efficiency firetube boilers	4	$475*
c. New cast iron boilers	2	$475*
d. Hot water pump (20 hp)		$25**

*One visit per year.
**Price per visit.

NORTHERN RESEARCH
AND ENGINEERING CORPORATION

NREC

39 Olympia Avenue · Woburn, MA 01801-2073 USA
Telephone: (617) 935-9050 · Telefax: (617) 935-9052
Telex: 465928 NOR RES WOB UD

June 16, 1995

Post-it® Fax Note 7671	Date 6/16	# of pages ▶ 4
To John Carter	From Jimmy Tang	
Co./Dept. Huitt-Zollars	Co. NREC	
Phone #	Phone # 617-937-4668	
Fax # (817) 335-1025	Fax # 617-935-9052	

Mr. John Carter
Huitt-Zollars
512 Main Street, Suite 1500
Forth Worth, TX 76102

Dear Mr. Carter:

We are pleased to provide our Preliminary and Budgetary Quotation No. 950-2361 describing the design and manufacture of replacement impellers for returning original capacity to various chillers described in your fax of June 14, 1995.

Based on our past experience, we believe that any capacity loss resulting from the conversion from CFC-11 refrigerant to HCFC-123 can be rectified by changing the impellers. This option will retain original operating conditions, including driving speed, and will avoid the need to change other system components such as the condenser. This presumes that the evaporator and condenser are adequately sized for the added HCFC-123 flow rates.

NREC proposes to design and supply new compressor impellers which will provide the pressure ratios and flow rates required by the use of the new refrigerant. NREC predicts that the present capacity of the systems using CFC-11 can be achieved using our high performance impellers with negligible increases in power consumption. However, we reserve the possibility of up to a 5 percent increase in power consumption.

This proposal assumes that we will work with a contractor of Huitt-Zollars's choice to perform the entire conversion of the machines for the customer. NREC will be responsible for:

- measuring compressor internals,
- designing and fabricating new impellers,
- balancing the impellers,
- supporting the contractor during the installation, conversion, completion, and operational testing of the converted system.

The selected contractor would be responsible for:

- removing and reinstalling the impeller,
- providing all other on-site support and conversion tasks.

NREC will retain overall responsibility for the satisfaction of the performance requirements. The impellers will be designed and manufactured to operate within the

specified original equipment. The impellers will be individually balanced, spin-tested, and assembled to the original rotor shaft.

Listed below are the preliminary and budgetary prices for the chillers you outlined in your request:

Area:	900	2200	1300	1350
Manufacturer:	York	Chrysler	Trane	Carrier
Make:	TurboPak HT	Airtemp	Centravac	
Model:	YTC3D3C1CJC	C2MN7792	PCV5FC1D1	19DK7894CP
Quantity:	One (1)	One (1)	Two (2)	One (1)
Budget Price:	$175,000	$250,000	$275,000	$35,000

Since NREC have not yet designed impellers for the specific York, Chrysler, and Trane compressors above, a significant non-recurring engineering and tooling effort is included in the budget price. NREC is currently evaluating market potentials and, within six months, may develop a design and production plan for the York TurboPak and Trane Centravac chillers. This new position could possibly reduce the costs for the replacement TurboPak and Centravac impellers.

This proposal is subject to the standard "Products Sales" Terms and Conditions of our parent company, Ingersoll-Rand. A copy of these Terms and Conditions is attached. If you have any questions about the quotation, please feel free to contact me at (617) 937-4668 or Mel Mittnick, Senior Applications Engineer, at (617) 937-4655.

Sincerely,

NORTHERN RESEARCH AND ENGINEERING CORPORATION

C. Jimmy Tang

Chi-Wu (Jimmy) Tang
Sales Engineer

CJT/ph
Enclosure

2361HUIT.DOC

CHILLER STUDY
FT. SAM HOUSTON

Prepared For:
Mr. John T. Carter
HUITT-ZOLLARS, INC.
512 Main Street
Suite 1500
Ft. Worth, Texas 76102
Project # 03-0185-04

Prepared By:
TOM McGREAL
YORK INTERNATIONAL
12901 Nicholson Road #260
Dallas, Texas 75234
(214) 620-8830

February 2, 1995

February 2, 1995

Huitt-Zollars, Inc.
512 Main Street
Suite 1500
Ft. Worth, Texas 76102

Attention: Mr. John T. Carter

Re: **Chiller Study - Ft. Sam Houston**
Huitt-Zollars Project 03-0185-04

Dear John,

Per your request, we are pleased to provide you with the following information concerning the study you are doing on the above referenced project:

Overview

900 Area	-	Served by (1) - 300 ton R-11 York YT Model
1300 Area	-	Served by (2)-500 ton R-11 chillers and (1)-440 ton R-11 Chiller

Some initial thoughts about the existing chillers:

Since the York chiller serving the 900 Area is "open" drive, it can be retrofitted quite inexpensively to R-123 (cost of approximately $20,000). However, there will be a tonnage deration and loss of efficiency (see attached chiller rating).

The units serving the 1300 Area will be hermetic chillers, and converting them to R-123 would be cost prohibitive, as the units would require total motor rework to become compatible with R-123. Replacement may be the only solution for this area, with the only exception being York "Codekits", new Open Drive Motor/Compressor Assemblies, field mounted. If the shells and tubes are in good shape, this option may make some sense.

- For the energy evaluation of electric centrifugal chiller full and part load performance, the curve you have will be excellent for the centrifugal chillers. As a baseline for full load efficiencies, use the following:

R-123 Model YT Tonnage Range 150 - 800 tons

150 - 250 tons use	.62 KW/Ton
250 - 350 tons use	.59 KW/Ton
350 - 675 tons use	.56 KW/Ton
675 - 800 tons use	.58 KW/Ton

R-22 Model YK Tonnage Range 350 - 2100 Tons

350 - 600 tons use	.62 KW/Ton
600 - 1200 tons use	.58 KW/Ton
1200 - 1700 tons use	.60 KW/Ton
1700 - 2000 tons use	.62 KW/Ton

12901 Nicholson, Suite 260, Dallas, Texas 75234
Telephone (214) 620-8830 • Fax (214) 484-7689

USA

Huitt-Zollars
Ft. Sam Houston Project

R-134a Model YK Tonnage Range 350 - 2100 Tons

350 - 600 tons use	.62 KW/Ton
600 - 1200 tons use	.58 KW/Ton
1200 - 1700 tons use	.60 KW/Ton
1700 - 2000 tons use	.62 KW/Ton

- For the Gas Engine Drive Chillers, utilize the R-134a selections (only refrigerant available on CAT Engine Drive Chillers), and use the following:

R-134a Model YG Tonnage Range 400 - 2100 Tons
6.6 MBH per ton (full load) from 350 - 700 Tons
6.2 MBH per ton (full load) above that

The part load curve will be slightly better than the centrifugal curve, but it will conservatively show the savings offered by gas.

- For the Water Cooled Screw Chillers, the part load curve will also be slightly better than the centrifugal, particularly through the 25% to 50% range. I've attached a "Marked Up" art load curve which should be used for the screw chillers. The full load efficiency base line should be:

R-22 Model YS Tonnage Range 125 - 675 tons, 1000 - 1200 tons

125 - 200 tons use	.64 KW/Ton
200 - 280 tons use	.62 KW/Ton
280 - 375 tons use	.62 KW/Ton
375 - 675 tons use	.64 KW/Ton

- For Air Cooled and Water Cooled Reciprocating Chillers, the full and part load points are attached.

- For the Gas Fired Absorption Chillers, utilize the attached curve and 12 MBH per ton for full load energy consumption.

We appreciate your interest in York products. Please feel free to call me if you have any questions.

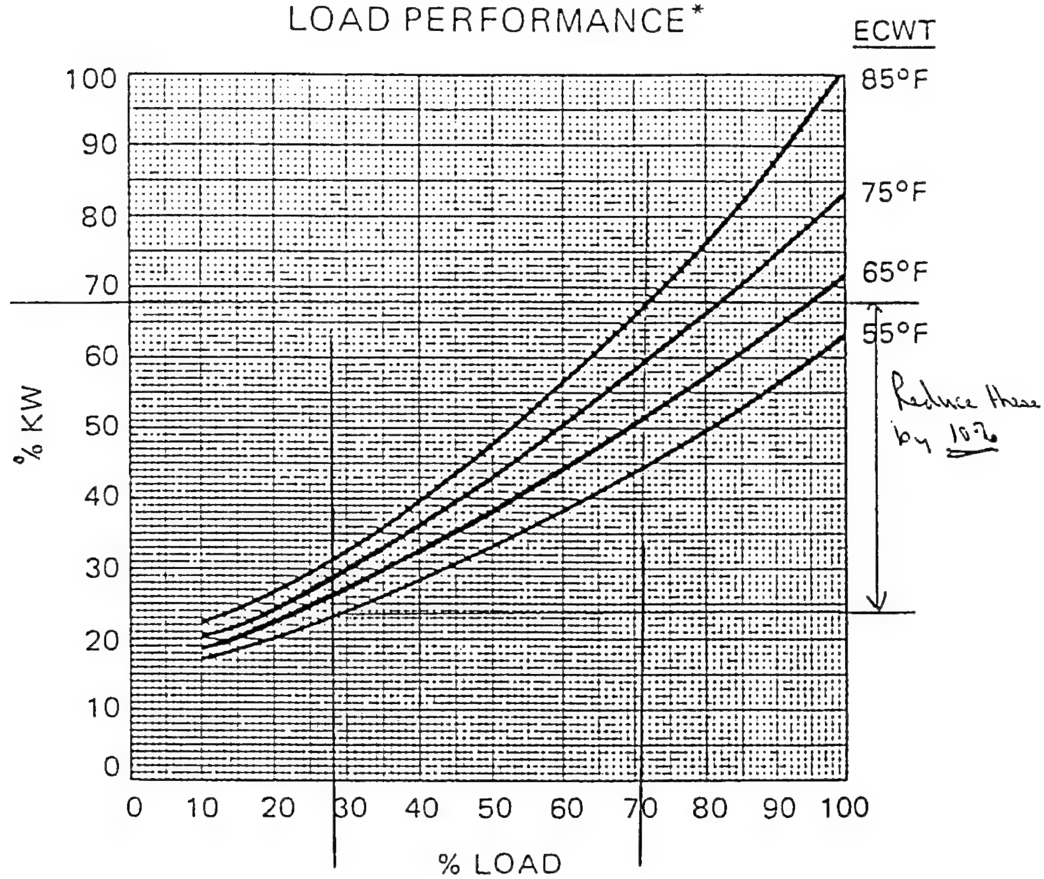
Sincerely,

Thomas J. McGreal
Systems Consultant

C:\WPWIN60\TOM\SAMHOUST

Water Cooled Screw Chiller

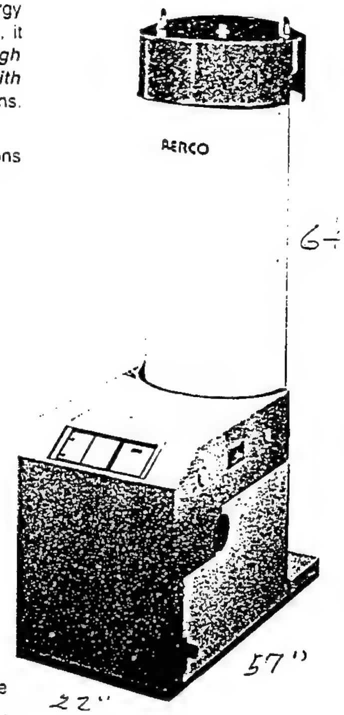
TYPICAL CODEPAK PART LOAD PERFORMANCE*



*Based on 2.4 GPM/Ton of 44°F leaving chilled water temperature; 3 GPM/Ton of condenser water; 0.0005 FF on both circuits.;

AERCO KC Gas Fired Hot Water Boiler System

The AERCO KC Water Boiler is a true industry advance that meets the needs of today's energy and environmental concerns. Designed for application in any closed loop hydronic system, it relates energy input directly to fluctuating system load, yielding ***seasonal efficiencies as high as 95%.*** The boiler can be used singly or in ***modular arrangements for inherent standby with minimum space requirements.*** Venting flexibility permits installation without normal restrictions.



The advanced electronics of each boiler module offer selectable modes of operation. The options available include:

Constant Temperature Internal Setpoint
Indoor/Outdoor Reset
4-20ma Linear Signal Response
AERCO Boiler Management System Integration
AERCO Combination Domestic Water/Boiler Plant

Regardless of the mode of operation, the load tracking capability of every unit delivers the ultimate in energy control through energy input modulation with a 14:1 ratio while meeting all load demands.

With condensing capability, the KC Boiler is ideally suited for modern low temperature as well as conventional heating systems. Because of the compact design with direct or conventional venting, the KC Boiler system is applicable to either new construction or retrofit application with the same excellent results. Efficiently, reliability, and longevity make the KC Boiler System a true step forward in heating system design.

KC1000 FEATURES

- Natural Gas or Propane
- 14:1 Turndown Ratio
- Direct Vent or Conventional Vent Capabilities
- ASME 150 PSIG Working Pressure Certified
- UL, ULC Listed, FM Approved, ASME Coded
- UL, ULC Listed for Alcove Installation on Combustible Flooring
- Quiet Operation throughout Firing Range
- Internal Low Water Cutoff and Dual Over Temperature Protection
- Compact Space Efficient Design
- Precise Temperature Control +/- 2F
- Optional Sealed Combustion

KC-1000 Specifications

BTU Input ....1,000,000 BTU/Hr†
Net Output @ full input..........860,000–915,000 BTU/Hp*
ASME Working Pressure ....150 PSIG
Electrical Requirement ....120/1/60 20 Amp
Gas Requirements..........8.5" W.C. Minimum @Full Load
14" W.C. Maximum
Vent Size ....6" Diameter
Water Connections ....4" Flanged 150 lb. ANSI
Gas Connection ....1-1/4" NPT

Minimum Water Flow..........25 GPM
Maximum Water Flow ....150 GPM
Water Pressure Drop..........0.23 Ft. 100 GPM
Water Volume ....23 Gallons
Control Range ....50F to 220F
Standard Listings & Approvals..........UL, ULC, FM, ASME
Optional Approval..........IRI
Weight, Installed..........1200 lbs.

*Output is dependent upon return water temp. and firing rate— see efficiency curves on reverse.

†Up to 2000 Altitude.

AERCO INTERNATIONAL INC.
KC HEATING BOILERS
PERFORMANCE COMPARISON

Case Date: Feb 13, 1995

Project Name:
BOILER JOB 1

Rep Firm: AERCO International, Inc.
Salesperson: Javier Piraneque
Design Firm:

Design Information:

Facility: MILITARY BASE
Square Footage: 000
BIN City Data: DALLAS

Competition: BURNHAM FIRETUBE
Fuel Consumed: Natural Gas
Its Max Known Thermal Effy:80.0%

Design Heat Loss 2,500,000 BTU/H TYPICAL FOR ANY LOAD.
Outdoor Design Temp: 10 F
Temp Differential: 20 F
Supply Water Temp @ Design:180 F
Indoor Design Temp: 70 F
# of KC-1000 Boilers: 3
With an Efficiency of 86.2%

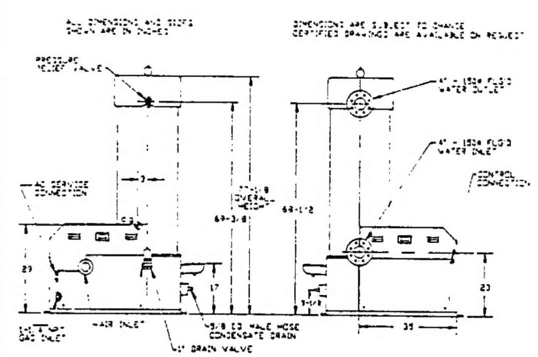
Energy Units Consumption

Outdoor AirTemp	ASHRAE BIN Hours	BURNHAM FIRETUBE Effy %	Energy	AERCO Boilers Effy %	Energy	Difference Energy Units
70	1,400	50.0	0	93.0	0	0
65	1,200	52.5	4,762	99.7	2,509	2,253
60	1,000	55.0	7,576	99.5	4,191	3,385
55	900	57.5	9,783	98.9	5,692	4,091
50	800	60.0	11,111	97.9	6,816	4,295
45	770	62.5	12,833	93.9	8,550	4,284
40	499	65.0	9,596	91.0	6,861	2,735
35	350	67.5	7,562	89.6	5,699	1,863
30	250	70.0	5,952	89.0	4,682	1,271
25	150	72.5	3,879	88.8	3,168	711
20	59	75.0	1,639	86.8	1,417	221
15	30	77.5	887	86.5	796	91
10	15	80.0	469	86.2	435	33
TOTALS:			76,049 EU		50,817 EU	25,232 EU

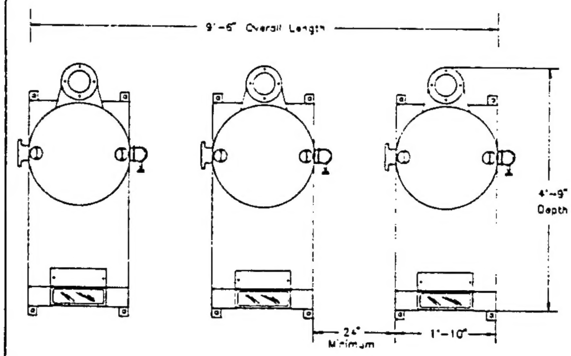
If BURNHAM FIRETUBE equipment is selected for this project, the INCREASE in energy usage over Aerco International KC Boilers will be approximately 49.7% MORE per year.

AERCO International reserves the right to revise any information contained within this program in accordance to the written legal agreement as stated in the pages of our users manual dated 5/94

Dimensions KC-1000 Boiler



Aerco KC-1000 Boiler Basic Dimensions



Typical Modular Boiler Dimensions (KC-1000-3)

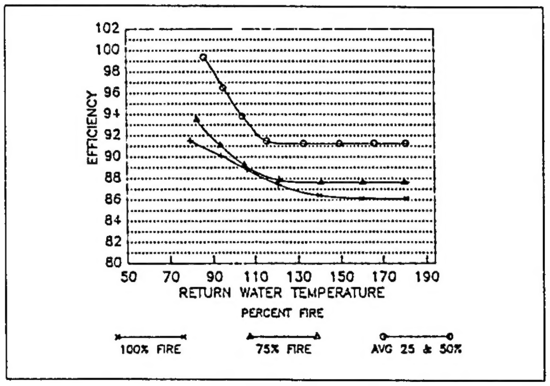
Ratings and Dimensions

Modules	Model	Mbh Input	MBH Output	Length	Depth	Height	Weight
	(a)	(b)	(b) (c)				
One (1)	KC-1000	1000mbh	860mbh-915mbh	1'10"	4'9"	6'8"	1200lbs.
Two (2)	KC-1000-2	2000mbh	1720mbh-1830mbh	5'10"	4'9"	6'8"	2400lbs.
Three (3)	KC-1000-3	3000mbh	2580mbh-2745mbh	9'8"	4'9"	6'8"	3600lbs.
Four (4)	KC-1000-4	4000mbh	3440mbh-3660mbh	13'6"	4'9"	6'8"	4800lbs.
Five (5)	KC-1000-5	5000mbh	4300mbh-4575mbh	17'4"	4'9"	6'8"	6000lbs.
Six (6)	KC-1000-6	6000mbh	5160mbh-5490mbh	21'2"	4'9"	6'8"	7200lbs.
Seven (7)	KC-1000-7	7000mbh	6020mbh-6405mbh	25'	4'9"	6'8"	8400lbs.
Eight (8)	KC-1000-8	8000mbh	6880mbh-7320mbh	28'10"	4'9"	6'8"	9600lbs.

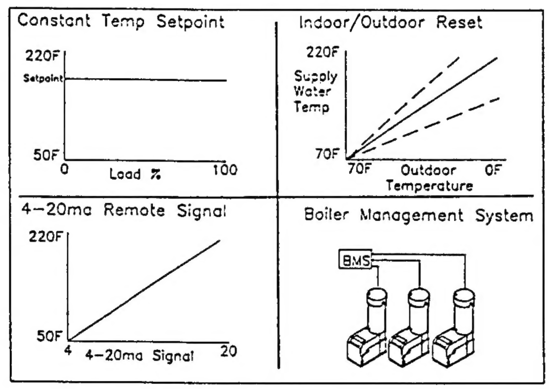
(a) Style to be Determined by Individual Application Requirement

(b) Altitude below 2,000'. Apply Altitude Correction Factor above 2,000.
(c) Output dependent upon application-see efficiency curves.

Efficiency Curves



Programmable Modes of Operation



Represented by:

GFB–1 BBC 08/93 5M

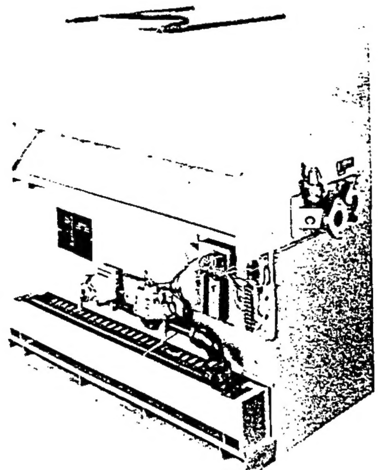
HEAT EXCHANGES • WATER HEATERS • BOILERS
CONTROL VALVES • STEAM GENERATORS

AERCO

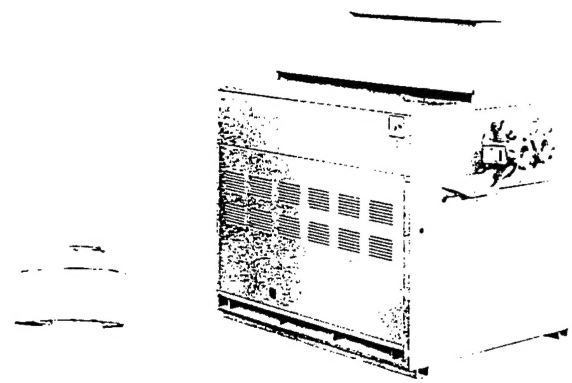
HOT WATER SYSTEMS

AERCO INTERNATIONAL, INC. • 159 PARIS AVE., P.O. BOX 128
NORTHVALE, N.J. 07647-0128 • (201) 768-2400 • FAX 201-768-7789

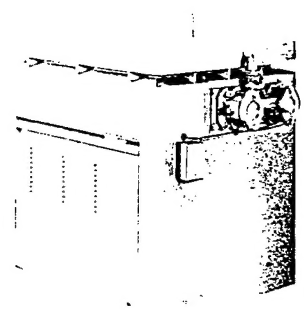
Series H hydronic boilers are packaged compact outdoor and slimline indoor units that fit in smaller places than conventional boilers—and do it without compromising or sacrificing performance. They are ideal for installation in multiples to meet almost any volume needs.



Type HQ
Indoor



Type HJ
Outdoor



Type HK
Indoor version shown.
Available with
vent cap for
outdoor use

TELEDYNE LAARS

Dimensions and Technical Data

Series H copper tube hydronic boilers are designed for closed system heating applications.
All models are design-certified by AGA for natural or propane gas.
Note: Two-stage with outdoor reset available.

Model	Boiler Ratings[1] Natural & Propane Gas: BTU Input x 1000	BTU Output x 1000 Indoor	BTU Output x 1000 Outdoor	Gas Connection[4]: Mechanical Modulation Nat.	Mechanical Modulation Pro.	On/Off or Two Stage Nat.	On/Off or Two Stage Pro.	Motorized Modulation Nat.	Air[3] Supply (Sq. Ft.)	Dimensions[1]—see drawings below: A	B	C	D	V (Dia.)	Indoor Draft Hood G	Outdoor Vent Cap H	Water Piping Conn.	Shipping Wt.
250	250	200	188	¾	½	—	—	—	.5	22½	32⅝	15¾	11¾	7	27	23	2	251
325	325	260	244	¾	½	—	—	—	.6	26¾	36⅞	17⅞	11¾	8	27¾	23⅝	2	316
400	400	320	300	¾	½	—	—	—	.8	31¾	41⅞	20⅝	11¾	9	29¾	26¼	2	371
500	500	400	375	—	—	1	¾	1	.9	30⅝	36½	20	6	10	—	—	2	407
625	625	500	469	—	—	1	¾	1	1.0	36½	42⅝	23	7	12	—	—	2	562
750	750	600	563	—	—	1	¾	1¼	1.3	42⅞	48¼	25⅞	8	14	—	—	2	603
925	925	740	694	—	—	1	1	1¼	1.6	50⅝	56½	30	8	14	—	—	2	798
1100	1100	880	825	—	—	1¼	1	1¼	1.9	58⅞	64⅝	34⅛	9	16	—	—	2½	863
1266	1266	1013	950	—	—	1¼	1	1½	2.0	66⅝	72½	38	9	16	—	—	2½	933
1466	1466	1173	1100	—	—	1¼	1¼	1½	2.5	76	81⅞	42¾	10	18	—	—	2½	1004
1666	1666	1333	1250	—	—	1¼	1¼	1½	2.9	85½	91¼	47⅝	10	18	—	—	2½	1146

Boiler standard with 2-stage firing on Models 500 through 1666.

Notes:

1. All dimensions nominal. Dimensions not shown in table are given in drawings below. Where measurements are critical request certified drawing.
2. The design of all models has been certified by AGA for natural and propane gases.
   All models conform to ASME Boiler Code for 160 PSI working pressure.
   Derate propane ratings for outdoor boilers by 10%.

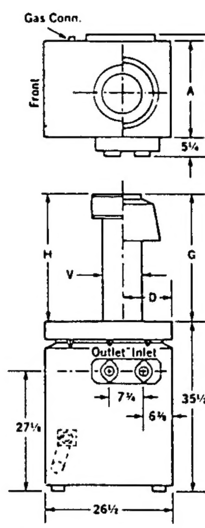
Derate BTU input and output 4% for every 1000 ft installation is above sea level. No derating necessary up to 2000 ft. elevation. Ex. At 4000 ft. elevation derate BTU input and output 16%.
For other boiler ratings:

$$\text{IBR Net BTU} = \frac{\text{Output}}{1.15}$$

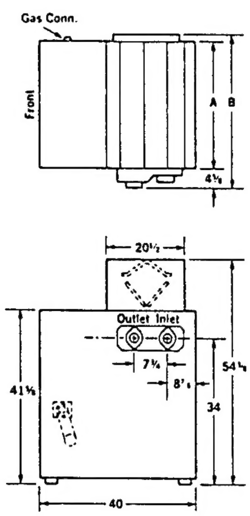
$$\text{EDR (Sq. Ft.)} = \frac{\text{Output}}{150}$$

$$\text{IBR (Sq. Ft.)} = \frac{\text{Net IBR BTU}}{150}$$

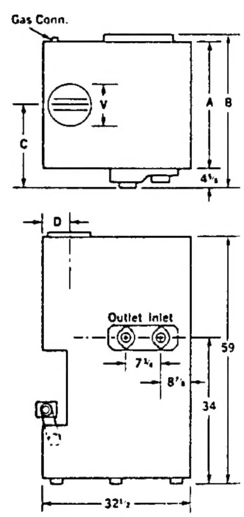
3. Area indicated is for each of two openings, one at floor and one at ceiling, communicating directly through a wall to outside air. For all other conditions refer to American National Standards Bulletin Z223.1—1974 Section 1.3.4.
   Check louver manufacturers for Net Free Area of louver. Correct screen resistance to net Free Area screen used.
4. Size shown is the connection at the boiler. For correct sizing of the gas supply piping and gas supply pressure see Document 1010.



Type HK
Indoor/Outdoor
Stacktop
250-400



Type HJ
Outdoor Only
500-1666



Type HQ—Slimline
Integral Draft Hood
Indoor Only
500-1666